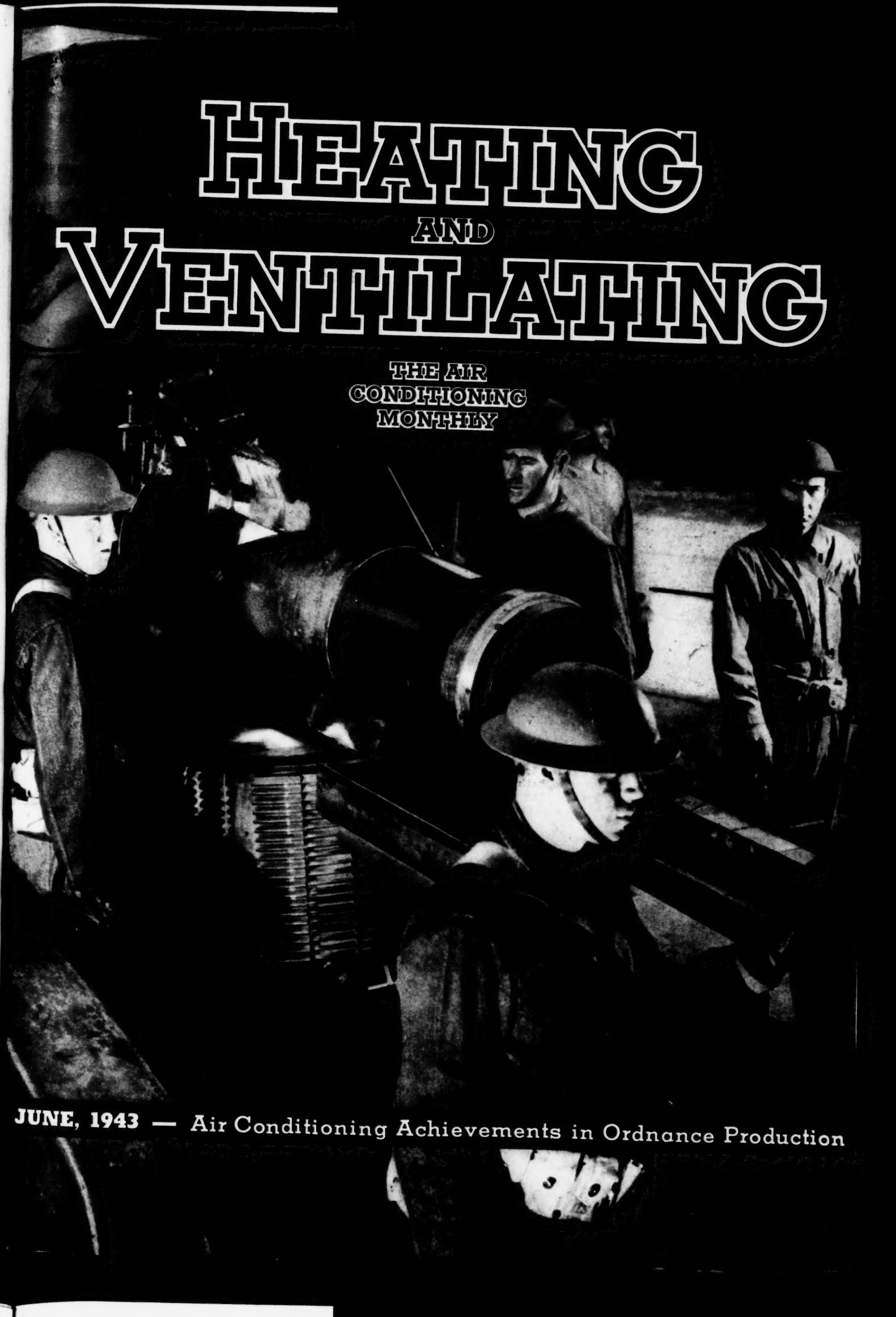
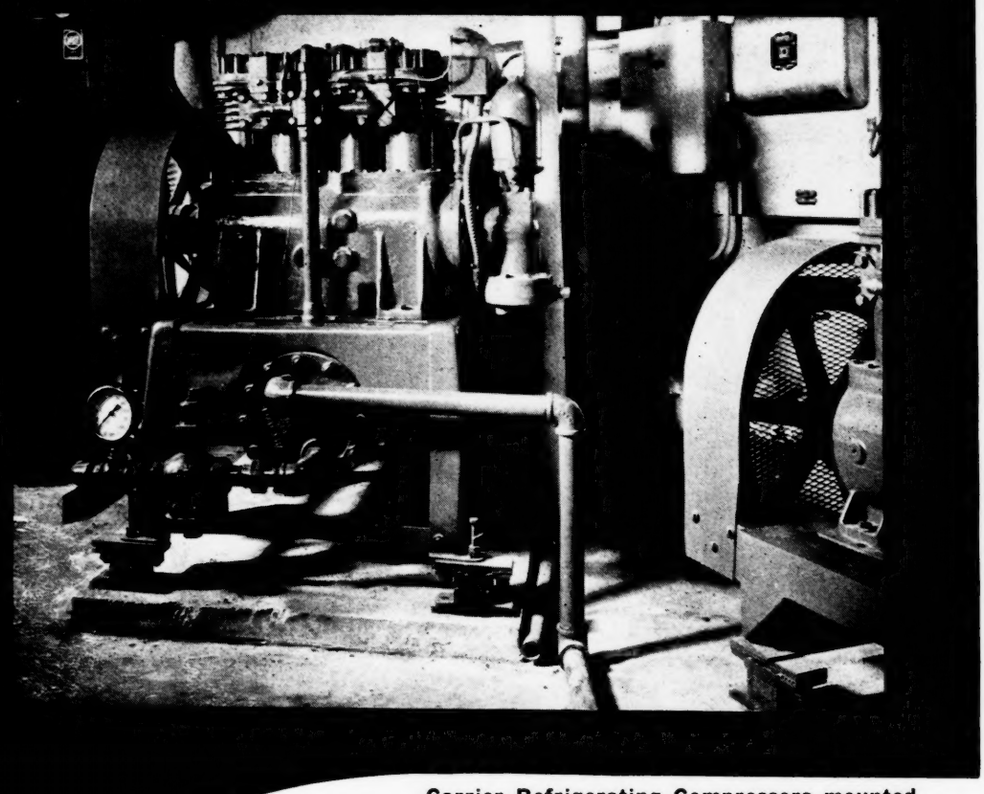
HEATING AND VENTILATING

THE AIR CONDITIONING MONTHLY

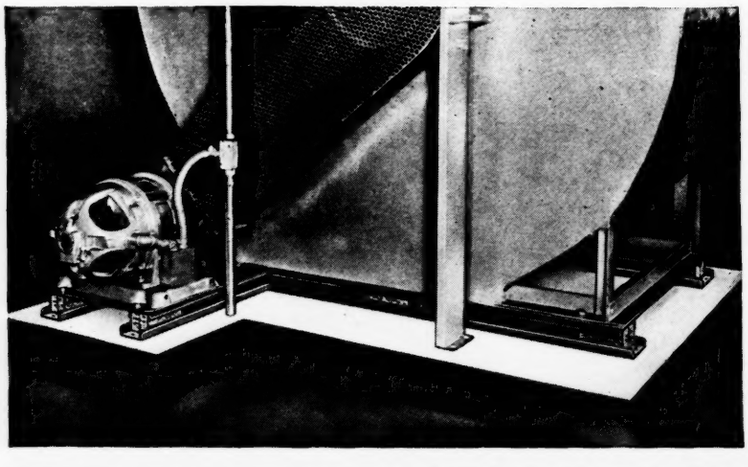


JUNE, 1943 — Air Conditioning Achievements in Ordnance Production

KORFUND
VIBRATION
CONTROL



Carrier Refrigerating Compressors mounted on all-welded Korfund type S Vibro-Isolators, utilizing steel springs as the isolating medium.



FAN AND MOTOR ON KORFUND VIBRO-BAR BASE.

Korfund Vibro-Bar Integral Base installed under a large fan and motor. Note how the welded steel construction provides an isolation base common to both the fan and its motor, thus maintaining constant alignment between them.

Unchecked vibration is as harmful to Production as Absenteeism. Control vibration and you gain—Improved Personnel Efficiency—Increased Machinery Life—Less Spoilage—Fewer Rejections.

Our organization is devoted to just one purpose—Vibration Control. Korfund brings you the engineering experience and knowledge gained from over forty years of experience and over 250,000 installations with cork, rubber, and steel springs.

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You cannot buy experience or knowledge. They can only be acquired through Technical Research, Experiments and plain Hard Work. Korfund engineers have incorporated both knowledge and experience in the application and design of our Vibration Control Products.

In your plant today—whether it be reciprocating or rotary machinery—whether it be a chronograph table or a drop hammer—Korfund is your answer for economical and successful vibration control.

THE KORFUND COMPANY, INC.

48-33 THIRTY-SECOND PLACE LONG ISLAND CITY, NEW YORK

for

engineers and contractors controlling the design, specification, installation and maintenance of heating, ventilating and air conditioning.

HEATING AND VENTILATING

The Air Conditioning Monthly

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THIS ISSUE : ONE DOLLAR

THIS MONTH'S COVER

shows soldiers at Fort Story, Va., loading a 16-inch howitzer shell, typical product of Army Ordnance plants such as those described in this issue, beginning page 35

MEMBER

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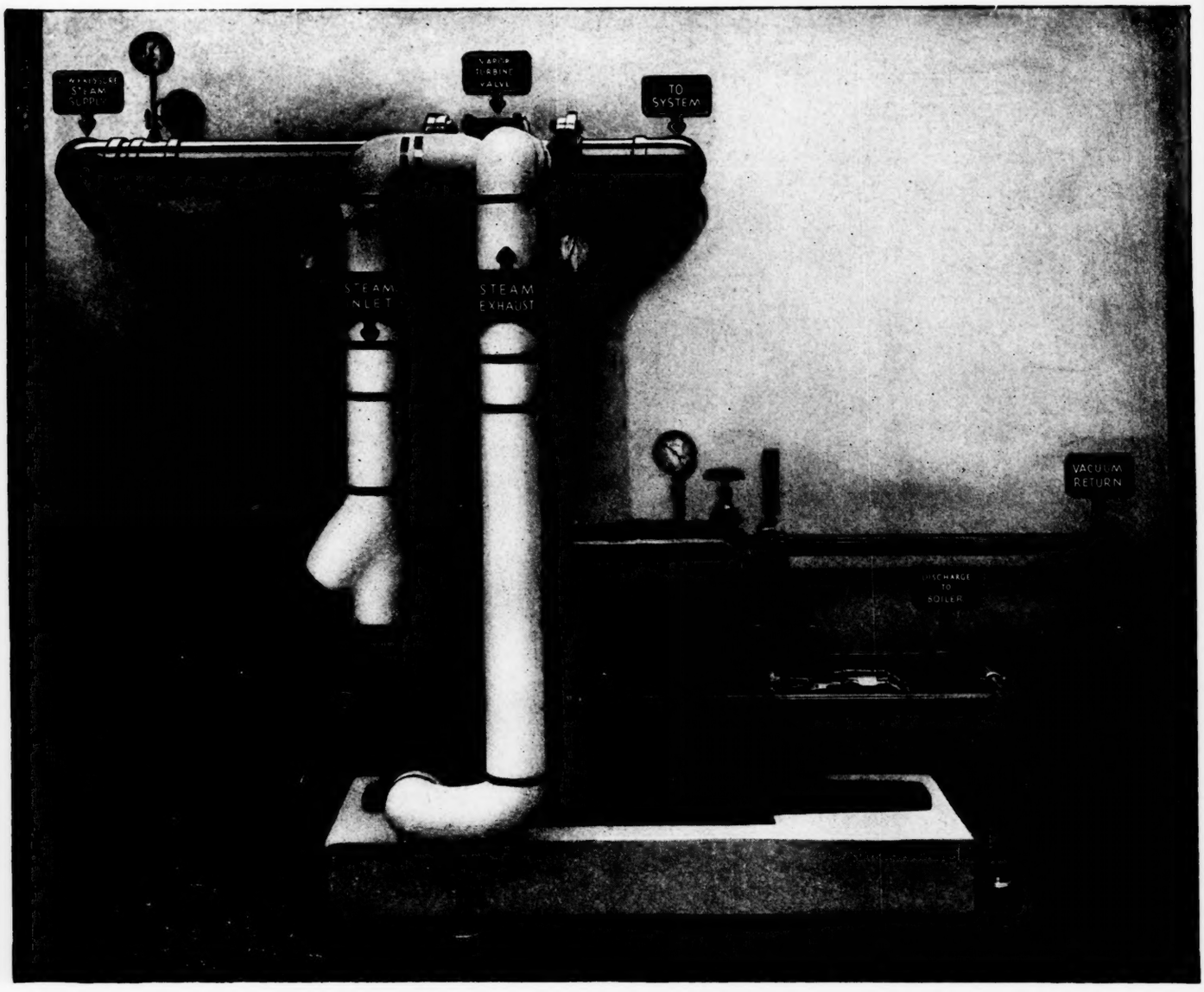
Interrupted Electric Service will not stop this NASH Heating Pump!



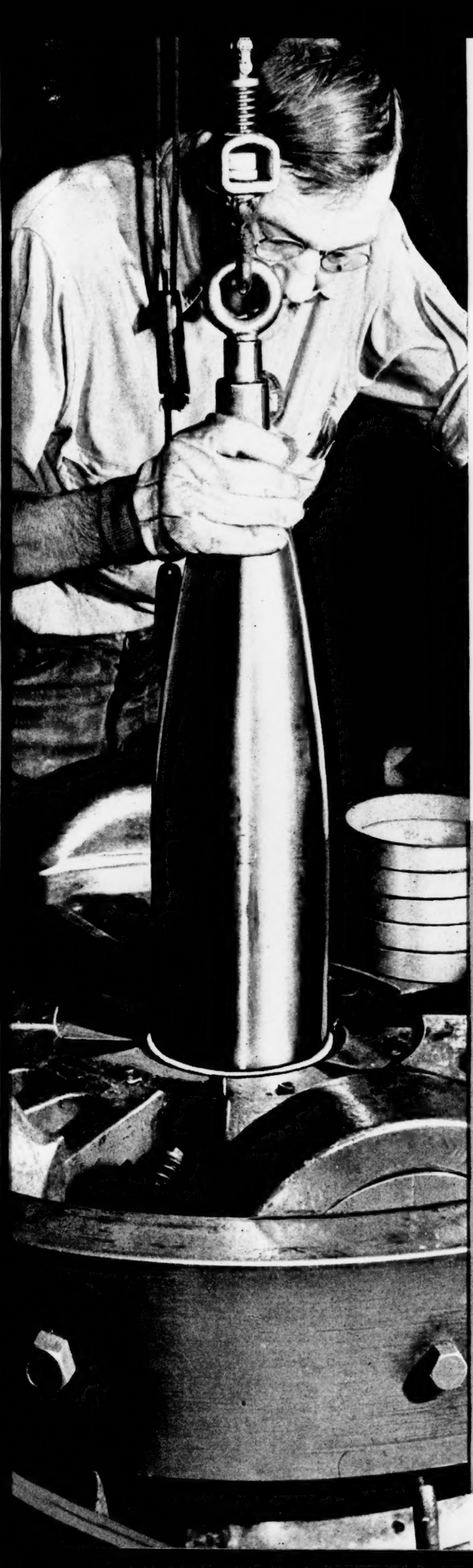
In Hospitals, Greenhouses, Schools, Public Buildings, Theatres, wherever heating systems must not fail, install the Nash Vapor Turbine, for it is independent of electric current failure, and continues to operate as long as there is steam in the system.

This is because the prime motive power of this economical pump is a special steam turbine, controlled by a unique "Vapor Turbine Valve", which automatically bypasses from the heating main a small portion of steam, the exact amount necessary to develop the power needed to remove the condensate and maintain the required vacuum on the system. Even this small amount is passed immediately back to the mains, and goes on to the system with little heat loss. This pump operates on any system, high or low pressure.

The Vapor Turbine is a most economical pump, for the elimination of electric current does away with current cost, the largest single item in the operation of an ordinary return line heating pump. Bulletin on request.

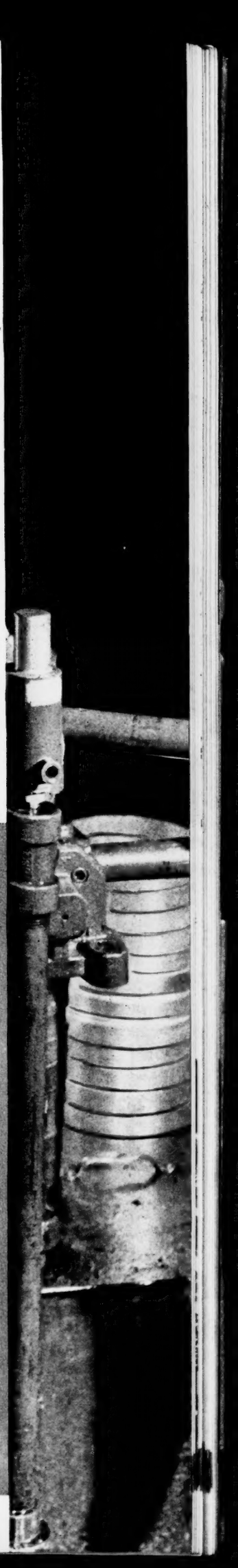
THE NASH ENGINEERING COMPANY

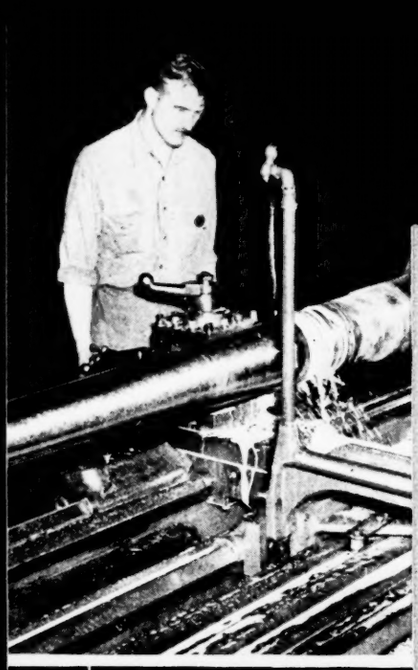
205-A WILSON ROAD, SOUTH NORWALK, CONNECTICUT, U. S. A.

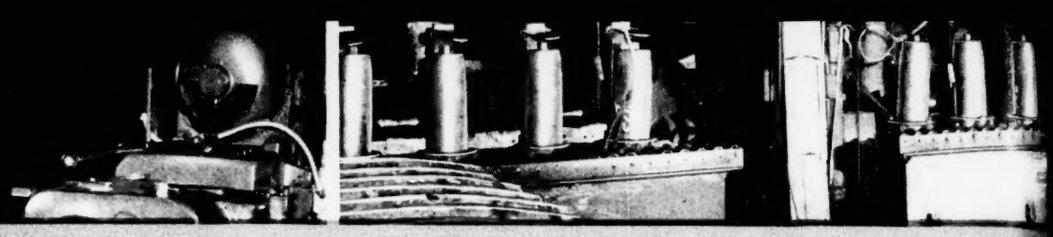


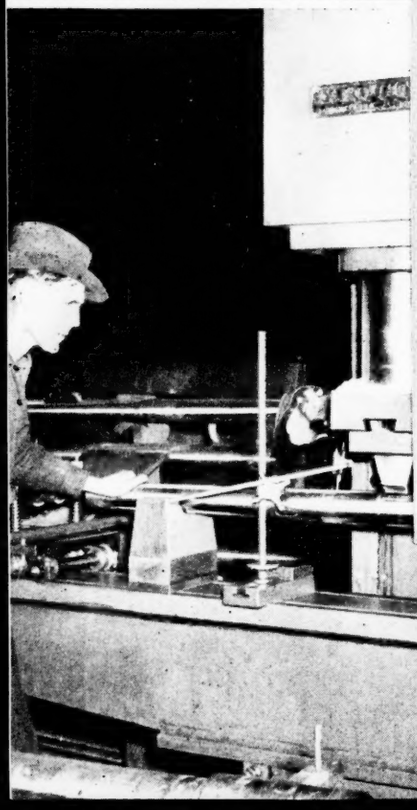
Air Conditioning
ACHIEVEMENTS IN ORDNANCE PRODUCTION

WITH AN INTRODUCTION BY
MAJOR GENERAL
LEVIN H. CAMPBELL
Chief of Ordnance Department
United States Army









OUR latest secret weapon, the "Bazooka", has already achieved a remarkable battle record.

During recent operations in Africa, for example, a small but strong fort gave considerable trouble to the Americans. One lone American soldier detached himself from the landing party, waded ashore, and with one shot from his gun effected surrender of the fort.

On another occasion, an American soldier armed with this weapon was suddenly confronted by six tanks. Unobserved, he fired hastily from cover. The projectile missed the tanks but splintered a large tree. The tank commander, an experienced officer, stopped fighting. The Americans were astonished.

These are two of many reports about the phenomenal firepower of this weapon.

Yet the Bazooka, however successful against Rommel, is only one of 2,000 weapons, comprised of more than 500,000 parts, which the Ordnance Department is constanty supplying our field armies in all parts of the world.

To the Ordnance Department falls the job of designing, developing, manufacturing, buying, storing and maintaining ordnance materiel, and trained ordnance personnel for field duty. Its responsibility covers the whole catalogue of army weapons and ammunition from sidearms, rifles, carbines, and machine guns, to light and heavy field artillery, coast artillery, anti-aircraft artillery. The Ordnance Department also develops and procures tanks, combat vehicles of all kinds, and self-propelled mounts. Finally, it "passes the ammunition."

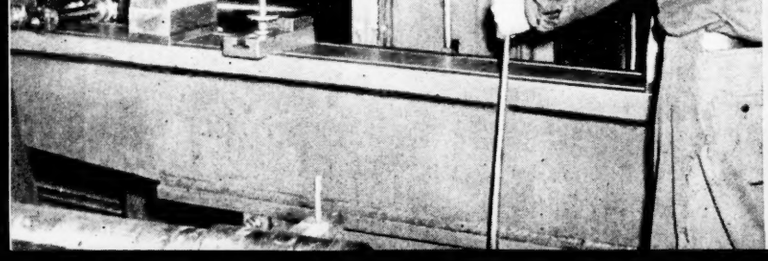
This has been the job of the Ordnance Department ever since it was created by an Act of Congress in 1812. During peace time, it fulfilled its requirements adequately through six research and manufacturing arsenals, together with a few contracts placed among civilian factories. Today, the Ordnance Department is one of the largest engineering, production, field maintenance and training aggregations in the world. Just now, in cooperation with industry, it is doing a $52,000,000,000 job.

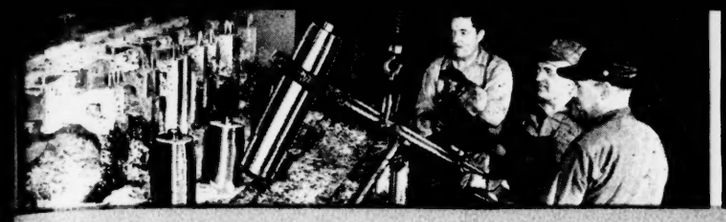
The Ordnance Department is divided into four principal divisions, which I will describe briefly, in sequence, as the Industry-Ordnance team goes into the fight.

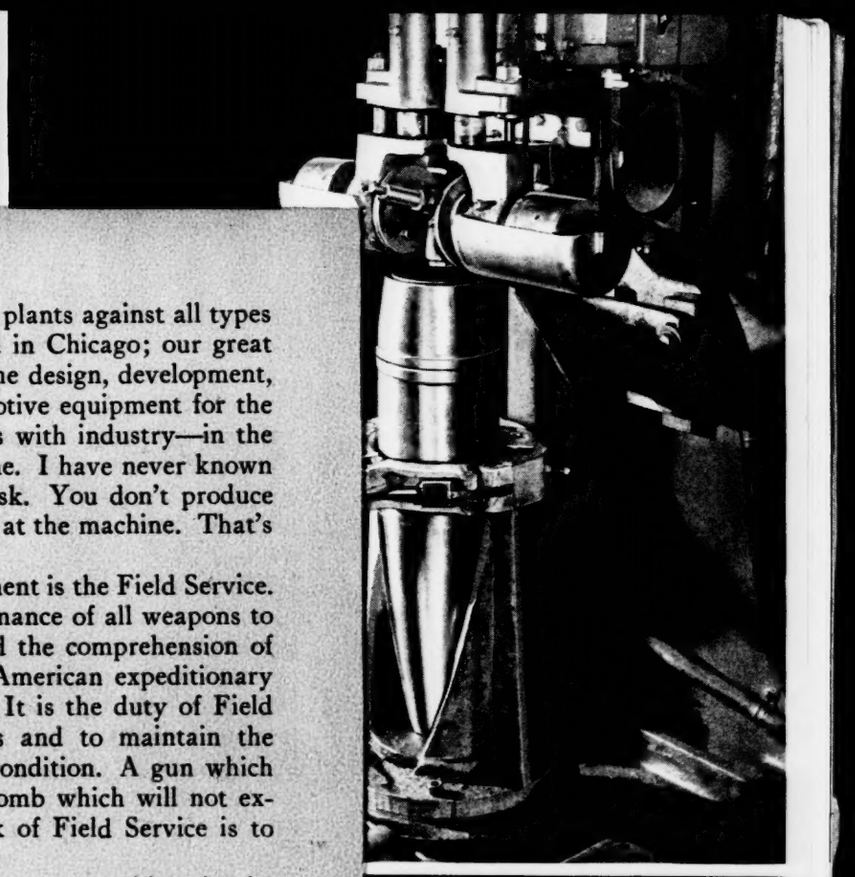
Our Research and Development Division engineers are responsible for designing and developing the great range of weapons and equipment required by the American soldier on the field of battle. This Division works in close cooperation with the great engineering research organizations of the country, with the results that we of the U. S. Army are, weapon for weapon, ahead of our enemies. The Division is keeping our fighting men far ahead of our crafty opponents. There is nothing that our Nazi and Jap enemies have disclosed which gives us any reason to doubt the superiority of American creative ability. In the firepower of our weapons, we are out in front. We intend to stay there.

The Industrial Service Division of the Ordnance Department has to do with armament production. It operates through the thirteen Ordnance Procurement Districts which cover these entire United States. This decentralization makes for the most direct and intimate contact with industry throughout this broad land.

As further evidences of Ordnance decentralization: our ammunition and explosive plants are administered from an office in St. Louis; our great







Safety and Security organization which protects our plants against all types of accidents and against enemy sabotage is located in Chicago; our great Ordnance Tank-Automotive Center which directs the design, development, procurement, supply and maintenance of *all* automotive equipment for the *entire* Army is located in Detroit. Ordnance works with industry—in the laboratory, at the work bench, on the production line. I have never known of a single shell that was produced at an office desk. You don't produce weapons there. You make them in the foundry and at the machine. That's where ours are being made.

The third great division of the Ordnance Department is the Field Service. This Service is charged with the supply and maintenance of all weapons to our troops in the field. This task is almost beyond the comprehension of the finite mind. We have more than seventy-five American expeditionary forces operating over the face of the globe today. It is the duty of Field Service to supply these forces with our weapons and to maintain the weapons and automotive equipment in operating condition. A gun which will not shoot, a tank which will not run, and a bomb which will not explode may well lose a battle and a war. The task of Field Service is to see that such does not happen.

The colossal proportions of the Ordnance maintenance problem in the field can be partially gauged from the fact that the vehicles of a motorized triangular division will make a column thirty miles long if placed at 10-yard intervals. There are 2,434 motor vehicles, and the prime movers tow 275 trailers and 116 guns. Together the 16,129 men and officers and the equipment of such a unit weigh 3,753 tons, and would require 1,707 freight cars or 17 trains, each a mile long, to move it. The maintenance of these vehicles is added to the servicing of the 2,000 other major items produced by the Ordnance Department.

The last great division of the Ordnance Department is that of Training. If we include civilian employees, the vast Ordnance school system is now engaged in training 75,000 men and women. The number of students is equivalent to all the wage earners in a city the size of Louisville, Kentucky. The entire system is under the direct supervision of the leading educators of our country who are on the Advisory Staffs of the schools.

The Army Ordnance Department is well organized to discharge its manifold duties. But the huge armament program is being carried rapidly forward not by the Ordnance Department alone but with the magnificent aid and support of our loyal and efficient team-mate and partner—American Industry. From an industrial standpoint, the Ordnance Department is guided by the one principle that it must be a unit with industry. We accept and we welcome industry in sharing our task, and we gratefully acknowledge the part that Industry is playing in the admitted success of the Department. With such backing we cannot fail! To the scientists and engineers of this country, to little business and big business, we give grateful acknowledgment for the part which they are playing in the constantly improving quality and quantity of Ordnance equipment.

Levin H. Campbell Jr.

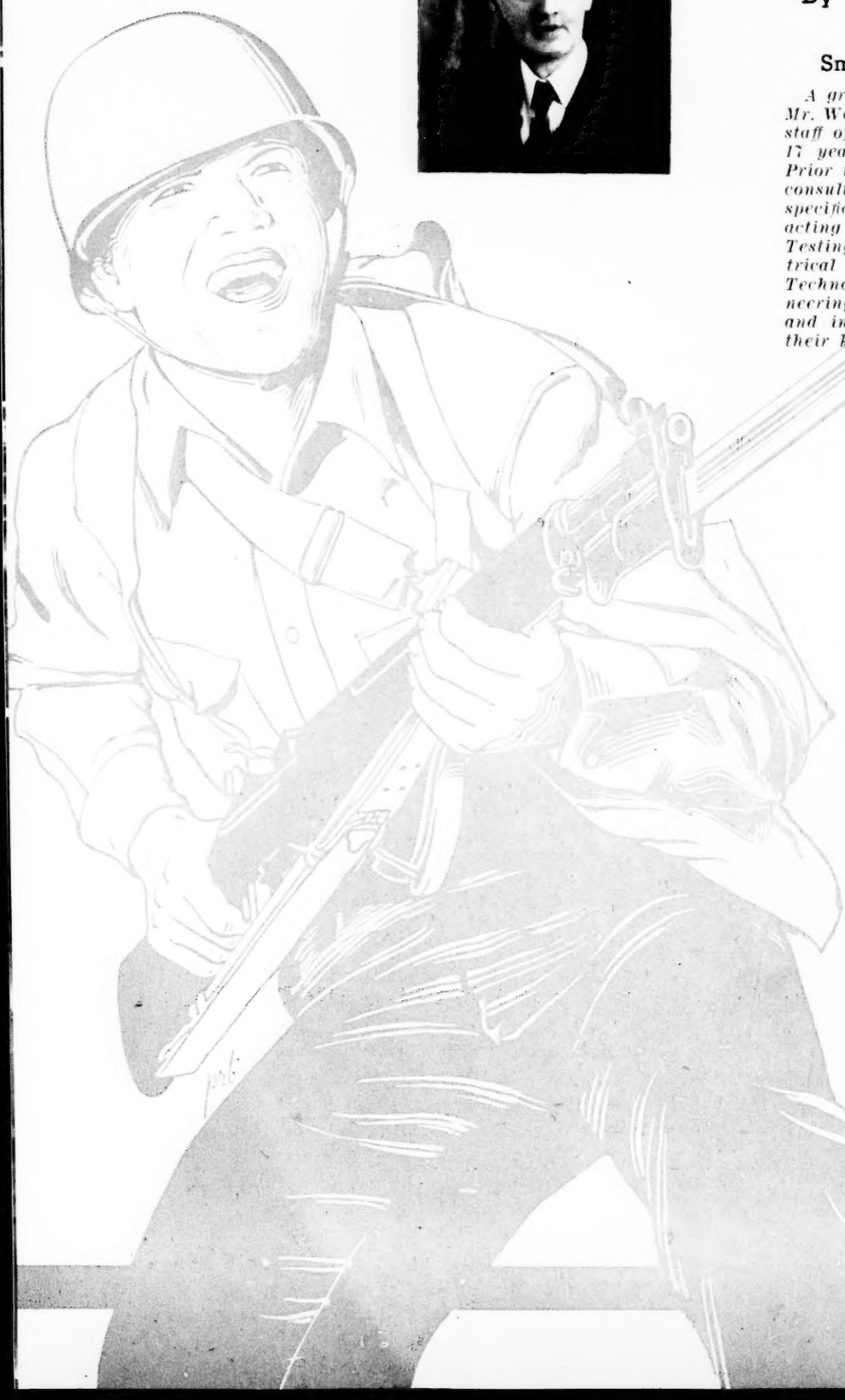
SMALL ARMS

By JOHN J. WOOLFENDEN

Engineer

Smith, Hinchman & Grylls, Inc.

A graduate of the University of Michigan, Mr. Woolfenden has been on the engineering staff of Smith, Hinchman & Grylls for over 17 years in various responsible capacities. Prior to that he was manufacturer's agent; consulting engineer; in charge of design and specifications for E. R. Little Company; acting chief, engineering department, Detroit Testing Laboratory; and Professor of Electrical Engineering, Lawrence Institute of Technology. Has been associated in engineering capacities with some of the larger, and in some cases the largest, projects of their kind.



Air Conditioning Achievements in ORDNANCE PRODUCTION

MUNITIONS

PART 1—DESIGN CONSIDERATIONS FOR THE HEATING AND VENTILATING OF SMALL ARMS MUNITIONS PLANTS

A QUESTION that naturally arises is, "In what respects does a small arms munitions plant differ from an ordinary industrial plant?" As a matter of fact, fundamentally, the differences are surprisingly few. There are, however, certain features which must be incorporated in the design and certain conditions existing which are either somewhat unusual in themselves or, by their influence, present the familiar problem from a somewhat different angle. If, therefore, the matter presented seems at times to be of a somewhat familiar, routine nature, it is well to remember that such quantities as the Btu, the cfm, the degree F and many other units remain the same, regardless of the nature of their application.

Spectacular results often are achieved by the proper application of ordinary means and commonplace processes. Mere size may be awe inspiring; but size, in itself, represents only the product of a multiplication. However, when customary limits are exceeded, the correlation of the component parts may require the introduction of features which depart from every-day practice—at least in their application.

Many articles have been published during the past several months descriptive of various plants engaged in work connected more or less intimately with war industries. While, in most cases, the activities carried on are unusual only on account of their magnitude or because of the fact that, heretofore, such operations have been confined to a limited number of plants, most of which were either government owned or were operated under government supervision, they present an aspect of novelty to those whose attention has, under normal conditions, been directed elsewhere. As a matter of fact, except that a single machine is now replaced by a battery of similar machines, and other units have been proportionately increased, the greater portion of these plants is similar to the newer of the pre-war plants; and necessarily so, since operations carried on in them are the result of experience gained from past performance.

It is certainly not reasonable to incorporate in any important process a piece of apparatus or construction, any method or material of which the utility, durability or dependability are not thoroughly established. Granted that, under the stress of emergency, new materials and new processes have come into use and that still more will appear, it is undeniable that a goodly number of these have been developed in the past and have been withheld pending the development of a demand for them.

In the following presentation, it will be noted that the decision arrived at is the result of the usual processes of elimination, of balancing advantages against disadvantages and possibilities, in the customary, routine manner.

No attempt has been made to identify any particular problem with any individual plant. This precaution may seem—and in many cases probably is—superfluous, but the reason for it should be obvious. Furthermore, in certain cases, the problem, only, is given with the possible solutions therefor and their advantages and disadvantages indicated. The reason for this is two-fold; first, that it may be inadvisable, at this time, to give more definite information and, second, that in many cases, the solution was influenced by local conditions to such an extent that the definite data would be of little use in other locations.

Steam Generation and Distribution

The proposed plant will consist of a large number of separate buildings distributed over several square miles of ground and, in this respect, resembles a group of institutional buildings more than an industrial plant. These buildings will vary in size from very large to very small; they will be set both singly and arranged in groups and will be used for the various activities customary in industrial plants, such as administration, manufacturing, storage, etc. Steam will be required for the usual space heating, water heating and other incidental uses and also for process purposes; often for several different uses in one building although, in some cases, it will be required for heating, only.

Projects of SMITH, HINCHMAN & GRYLLS, INC., Architects and Engineers, Detroit. Mich.

The highest required steam pressure will be that for process steam, which will be very much in excess of that normally required for heating purposes.

The important questions are whether the steam should be supplied from one or more central boiler houses or from a number of separate boiler plants located in the buildings, themselves, each supplying a building or a group of buildings; also whether the plant should be simply for steam generation or should include electric generating equipment.

It must be borne in mind that, while some of the plants may be permanent structures, many of them are constructed with the idea that they will operate for a period of only a few years and will, therefore, be of less permanent construction.

In any event, these questions should not be decided without due deliberation. There are advantages and disadvantages on both sides and the decision arrived at will, of necessity, affect other features of the design. The relative efficiency, cost of operation, first cost and other similar items are no different from the ordinary installation. Under present conditions, however, the availability of such new apparatus as boilers, feed water heaters, pumps, turbines, engines and other plant equipment may be one of the governing factors, since construction must be started at the earliest possible moment and carried to completion with the least possible delay.

There is also another very important consideration, with several correlated results attached; viz., the vulnerability to damage from sabotage or from enemy attack; of this, more will be said later.

While the generation of electric current is not, in itself, a matter of heating and ventilation, it may be directly involved since, if the current were generated in the plant by means of steam driven prime movers, the use of the exhaust steam would have to be considered, with the normal indication strongly toward the use of a central plant. This, in turn, however, would involve a duplication of the steam distributing system, were the exhaust to be utilized for heating, since process steam pressure and exhaust steam pressure would be quite different. Furthermore, the size of the piping required for the distribution of the low pressure exhaust steam should not be overlooked.

It must also be remembered that the lighting load will be quite heavy; that, during the emergency, the plant will operate twenty-four hours per day and that there will be no steam required during the summer months except for process purposes, air conditioning and water heating.

If a standby generating plant is to be included, it must be of adequate capacity to furnish the current required for all essential operations, day or night. Except for trial runs, it is likely to be subject to long periods of idleness. If such a plant be provided with Diesel engine driven generators, it will be independent of steam supply, can be put into operation very quickly and will be equally suitable whether the boilers be in a central plant or in individual buildings.

Fuel

In connection with the generation of steam, the matter of fuel must be considered. In some locations, gas or oil may be available; in others, coal must be used. In any case, local conditions, together with government restrictions, will be the important factors. The relative advantages and disadvantages of the various types of fuel are, otherwise, to be decided upon the usual basis.

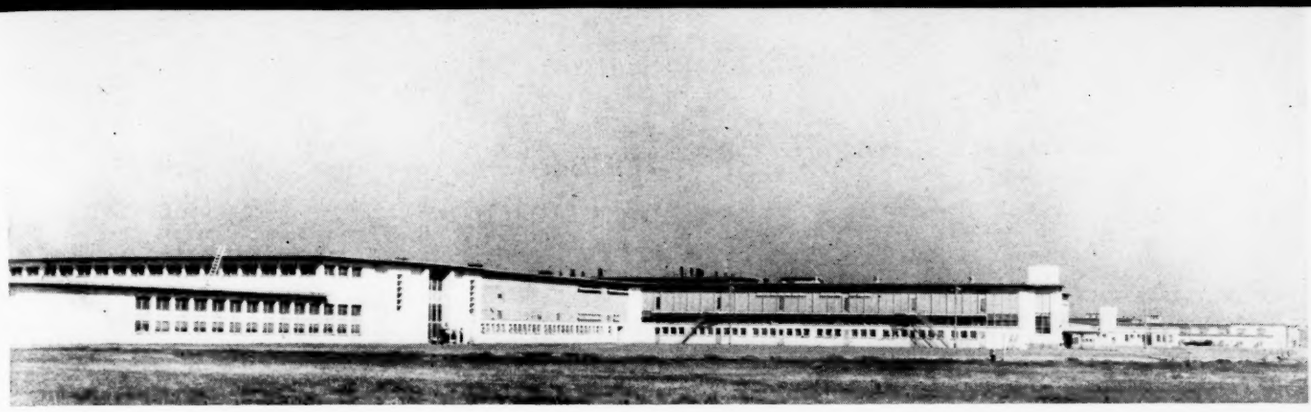
As conditions may change from time to time and, as a result, the availability of any one type of fuel also change, the use of a dual-purpose or even of a tri-purpose firing mechanism may be found advantageous.

In the case of stokers or pulverized coal burners, the burners and the fuel handling apparatus should be so proportioned as to be adapted to the use of the coals locally obtainable, even though fuel from an outside source of supply be normally used, thus providing against the contingency of interruption of fuel shipments.

The handling and the storage of the coal and the disposal of the ash introduce no unusual problems.

The size, type and arrangement of the chimney (or chimneys) will be dependent upon the nature of the fuel burned, the type of firing mechanism used and the degree to which it is desired to render the plant inconspicuous. Furthermore, tall chimneys, especially without warning lights—as they would be, during a blackout—present a hazard to aeroplanes. It is obvious, if smokeless combustion is to be obtained, especially if solid fuel is used, adequate combustion controls suited to the type of firing mechanism and the fuel or fuels to be used must be provided.

In the ultimate analysis, the selection of the type of plant and the nature of the fuel used differs from the ordinary only as it actually resolves itself into a question of the probability of sabotage or attack and, of that, the military authorities should be the judges. If the probability of attack is not to be considered, the customary commercial considerations, as modified by the emergency conditions, will govern. Any decision arrived at should be regarded as tentative until it has been presented to the military authorities having jurisdiction over the construction, together with the reasons prompting it, and their approval obtained.



Exterior view of one of the main manufacturing buildings at a Midwest munitions plant. Construction is of the permanent type.

Dust

In certain of the operations involving the handling of dry explosives, more or less dust is an inevitable concomitant. While the amount of dust created or raised may be almost imperceptible at any given time, the effect is cumulative. If no remedial measures are applied, a highly dangerous condition is almost certain to result. With even an almost invisible film of such dust covering the interior surfaces of a building or room, a spark could easily result in a flare that would involve all surfaces so covered; and the finer the dust, the greater the danger.

True, the total amount of the dust might be small and the expansive effect of the gases of combustion themselves very little, but in connection with the ignition of the dust on interior surfaces, there are several other effects to consider, such as the possible ignition of other explosives within the room; injury to the occupants; the inhalation of noxious fumes and panic, both in the room itself and, possibly, in adjacent areas. In addition to all these, there is the possibility of sufficient heat being suddenly generated to cause the air in the room to expand with explosive violence. Of course, in the event of any combustion within the room, there is the additional possibility that the dust in suspension in the air would also ignite and add to the destructive effect.

It is, therefore, of supreme importance that every precaution be taken, first, to prevent the accumulation of dust; second, to prevent the ignition of such dust as may accumulate in spite of precautions and, third, to incorporate in the design all features which facilitate effective cleaning and make good housekeeping feasible and as convenient as possible.

In order to prevent the deposit and accumulation of dust in places where it might constitute an actual hazard, horizontal surfaces "facing upward" are to be avoided, as much as possible, as are also pockets and irregularities of surfaces which might serve as collecting points for dust.

For that reason, in all locations where the dust hazard exists, it is desirable that the spaces above horizontal ducts which run near the ceiling, the spaces between adjacent ducts and those between a duct and an adjacent wall, beam, or other similar feature of building construction, be closed off from the room; that an ample number of access doors and cleanout doors be provided; and that, where necessary, the ducts be constructed in sections, coupled together by gasketed flanged joints, so arranged that the sections can be conveniently taken apart for cleaning.

Where, in the judgment of the military authorities it is so required, adequate provisions against *flare backs* should be provided at all supply and exhaust openings into ducts; especially the latter. This protection operates on the principle of the Davey safety lamp and may consist of two reinforced metal screens, preferably of copper, in each opening. These screens should be slightly separated, should properly fit the duct opening and should be set in frames securely fastened to the sheet metal work and arranged so as to be readily removable.

These screens must be of rather fine mesh—say about 12 per inch (the exact fineness should be sub-

ACKNOWLEDGMENT

The small arms munitions plants described in these articles are not the work of any one individual or any one organization. Smith, Hinchman & Grylls, Inc., carried through the work of designing and of supervising the construction of two of them, complete; in the case of the other five, the work was divided among Smith, Hinchman & Grylls, Inc., and another firm, as associates. In such cases, the former handled the buildings and equipment, the associates the work outside the building.

Smith, Hinchman & Grylls desires to express its appreciation of the close cooperation of the Army Engineers, Army Ordnance Department, Remington Arms Co., Inc., United States Rubber Company and Federal Cartridge Corporation; and also to acknowledge its indebtedness to the following:

Consultants: **The A. J. Brandt Company, industrial engineers, technical authorities on equipment, manufacturing operations and process development.**

Engineers (Associates): **R. J. Tipton; Howard R. Green; Toltz King and Day, Inc.; Jerry Donohue Engineering Company, and A. E. McMahon.**

Engineers: **Black and Veatch; C. A. Haskins, Burton Lowther and D. J. McQuail.**

Contractors: **Broderick and Gordon; J. S. McLaughlin & Sons; Central Engineering Construction Co.; Preister Construction Company; Walbridge-Aldinger; Foley Bros.; Massman Sons; The Hutter Construction Company; Rudolph Weitz; The Fox Valley Construction Company, and their various sub-contractors.**

Portion of a representative manufacturing building, over 1000 ft long, at a small arms munitions plant such as described by the author. The complete plant in such a project consists of a large number of buildings distributed over several square miles and resembles a group of institutional buildings more than an industrial plant.

mitted to the military authorities for approval)—and it is necessary, therefore, that the requirements in this respect be established as early as possible, so that due allowance may be made for the additional resistance in proportioning the opening sizes and in selecting the fan.

A moment's reflection will show that, when explosive dust constitutes a hazard, the recirculation of air in connection with the ventilation would increase that hazard, not only in promoting the accumulation of the dust in ducts or casings, on filters, and on other surfaces, but in the possibility of exposing it to the action of moving parts of apparatus, such as fans. It follows, then, that when the ventilating system is in operation, dust laden air is constantly being emitted from the ventilated space.

It is to be expected that, unless adequate preventive measures are taken, the dust from this air will be deposited about the premises at the whim of the air currents; much of it, probably, on the roof of the building itself.

To attempt to remove this dust from the air by means of filters would result in an undesirable accumulation of explosive on the filter surface and, in the elimination of one hazard, simply create another at or in the building itself. Such dust can, however, be removed and rendered relatively innocuous by means of suitable water sprays, the most convenient form of which is to be found in the familiar air washer. The waste water from the various pieces of equipment of the air conditioning system, such as the compressor jackets, the condensers (if of the shell and tube type) can usually be utilized to supply the spray nozzles, the more so as the areas in which such dust originates are air conditioned.

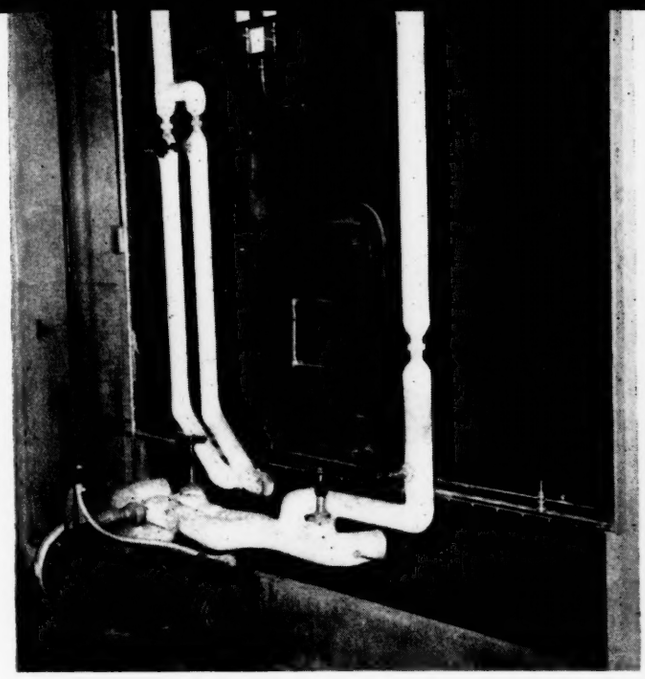
The spray water should not be recirculated and both the overflow and the drain from the washer tank should be run to a suitable separating sump, located outside the building, in which a canvas bag is arranged to receive the influent and act as a filter to retain the solids. The effluent from this sump can then be run into the sewer.

It should be noted, however, that certain types of explosives, e g., dynamite, owe their explosive properties to a water soluble compound and such types should not be subjected to leaching. It is not necessary to discuss here the nature of the materials handled even should it be permissible to do so, but it is sufficient to point out that, as a matter of general precaution, the decision of the military authorities as to the propriety of dust collection by the spray washing method should be obtained in each case.

Sparks

Ever since the handling of gunpowder became common, sparks have been the *bete noire* of the powder magazine. Extensive precautions have been taken to prevent their generation and, as processes change and our knowledge becomes greater, the present ideas of protection in some respects involve precautions much more elaborate than those of the past.

Broadly speaking, sparks, aside from those result-



(Left) Air washer equipped with a Goulds water spray pump for removing powder dust from exhaust air as it is vented from a tracer charge wing. This prevents formation of dangerous dust accumulations on the roof. (Right) Heated air is supplied to this plant cafeteria through the duct overhead. Outlets are U. S. Register Co. grilles.

ing from actual active combustion and from current electricity, are produced by impact, friction or electrostatic charges. The first and the last of these may involve friction to a greater or less extent, although it is not necessarily an essential. Static charges may result from atmospheric electricity. There is no indication of their presence until the sparking potential is reached. Hence they are insidious and extremely dangerous.

Since in the case of either impact or friction ferrous metals are the commonest contributors to the production of sparks, it is desirable that no two parts of ferrous metal, between which there is relative motion, be allowed to be in contact or to make contact with each other. For this reason, damper stops, damper spindle bearings, shaft collars and other similar parts, should be of copper, bronze, or some other suitable non-ferrous metal or should be adequately protected against contact with ferrous metal by a suitable ring, stop or pad of non-ferrous metal. The same holds true of damper chains, pulleys, guides and other similar equipment and it may also be desirable to protect against contact between the fan wheel and the fan housing by providing a suitable guard ring of non-ferrous metal on each side of the inside of the fan housing, unless the fan wheel, itself, is of non-ferrous metal.

In certain locations, where accidental impact of metal implements with the apparatus or equipment might produce a spark, all exposed metal work, including air ducts, piping, radiators and radiator shields, must be of copper or other approved non-ferrous metal. This is particularly true in the case of locations devoted to powder storage or to primer storage.

In the face of such precautions, it seems to be an anomaly that much of the manufacturing equipment in hazardous locations is built of cast iron and steel. However that may be, the use of the non-ferrous construction is customary and should be departed from only by the specific permission of the military authorities having jurisdiction over the construction and then only to the extent stipulated by them.

To overcome the danger due to electric sparks resulting from static charges, all metal apparatus and equipment must be thoroughly and adequately grounded. This provision is most important and must not be overlooked.

Water Supply

While the matter of water supply is not usually considered as being included in the design of a heating and ventilating system, nevertheless the characteristics of the available water must be ascertained and taken into account, since the quantity available, its temperature and its hardness may have a decided effect in the selection of apparatus. This is especially true if the supply be taken from deep wells, and the temperature is low.

If possible, waste water from jackets, condensers, and the like, should be utilized before discharging it into the sewer. An example of such economy has been mentioned above, in connection with the exhaust air washer equipment.

Drainage

This, like the water supply, is not, strictly speaking, a part of the heating and ventilating system, but is of importance in connection with its design since there must be an adequate provision for the disposal of the waste water from air conditioning appa-

Firing ranges where the ammunition is tested have their own special ventilating problems. The exhaust heads of a typical range are shown here. In these ranges guns are fired through small ports in the wall of the firing room at a target located at the opposite end of the range. The ventilators remove the gases generated and prevent their being swept back through the ports into the firing room.

ratus; where necessary, special sumps such as those mentioned in connection with the exhaust air washer must be provided.

Special Ventilation

There are certain processes in munitions plants which call for special treatment in regard to ventilation. These are (a) the firing ranges, where the ammunition is tested and (b) the acid pickle vats. These will be analyzed below, in their respective order.

(a) In connection with the firing ranges, there are two conditions to be dealt with viz., those in connection with the firing ranges proper and those attendant upon the operation of the functioning and casualty range.

The first of these presents a problem of providing sufficient air change to expeditiously remove the gases resulting from the burning of the powder. In these ranges, the guns are fired through small ports in the wall of the firing room at a target, or butt, located at the opposite end of the range, the intervening space being simply for the purpose of obtaining the desired distance between the weapon and the target. The targets are backed up with loose sand to act as a stop.

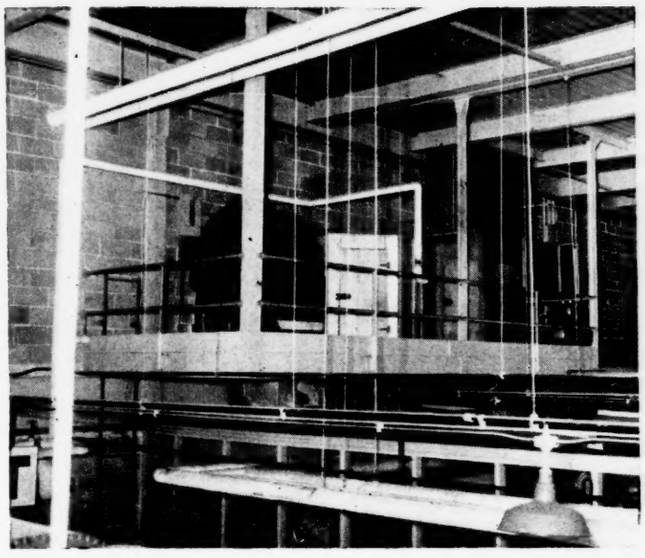
The gases from the gun are naturally projected forward towards the target with a high initial velocity and expand rapidly, losing velocity accordingly. It is obvious that the logical scheme of ventilation is one that will keep these gases moving in their original direction and prevent their being swept back through the ports into the firing room.

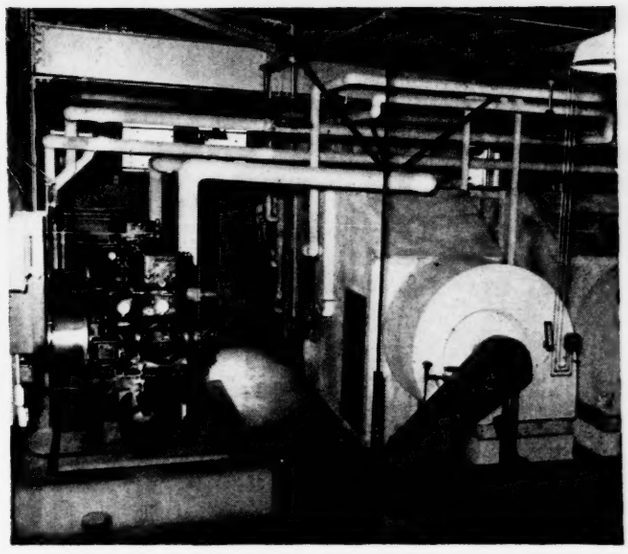
As the ports are relatively small and the cross sectional area of the range is large in proportion thereto, it is not practicable to admit all the air required into the firing room and introduce it to the range proper through the ports.

In consequence of this condition, sufficient air must be introduced into the firing room to provide the necessary ventilation therein. This air, drawn through the ports into the range proper, must be supplemented by the necessary quantity of air admitted directly to the range proper, immediately adjacent to the firing room so as to avoid any back travel. The entire amount of air, averaging about one air change per minute, is then to be drawn down the length of the range by means of an exhaust fan and removed through vent, or exhaust, openings adjacent to the targets.

As the ranges are steel-faced on all exposed surfaces, it is to be expected that at least some of the bullets will ricochet. For that reason, the ventilating openings must be so located and arranged as to minimize the probability of their being entered by the bullets and, for the same reason, all thermostats and similar equipment must be adequately protected against damage.

The openings themselves are probably best located in the ceiling; and the ducts for several feet back from them should be of steel plate, heavy enough to prevent their being punctured. The shape





(Left) Cafeteria ventilation is supplied by this conditioning unit. A Clarage supply fan, Trane steam coils and Minneapolis-Honeywell controls are included in this equipment. (Right) Close temperature and humidity control is maintained in a tracer loading department by this complete conditioning unit. The Vilter Freon compressor at the left cools the spray water.

of the openings and their exact location should be such as to reduce the probability of damage to a minimum and provide for uni-directional flow of air. Thermostats are best located inside the return air duct at some suitable convenient point, adjacent to an access door.

On account of the extent of the ranges and the nature of the operations carried on therein, the heating of the ranges and of the firing rooms is best accomplished by "hot blast", in connection with the ventilation. The volumes of air and the temperature at which it is admitted will depend upon the size of the range, the exposed surface, and other similar factors. It may be suggested, however, that the velocity of air through the ports be not less than 400 fpm and that the air change in the firing range be ample—as high a rate as one air change per minute may be required.

In the case of the functioning and casualty ranges, another factor is introduced, namely, dust arising from the sand in the stop.

There are no targets in these ranges. The gun fires through a port in the wall of the firing room. The bullets pass through an opening in an intermediate partition, and finally enter the sand through an opening in the retaining wall. This latter opening is provided with baffle plates extending back from the top and sides to prevent the sand from being splashed out.

These ranges are used for testing the ammunition under rapid-fire conditions and the continuous succession of bullets striking the sand grinds it into a fine powder which fills the air of the enclosure between the stop and the intermediate partition. The function of the intermediate partition is to prevent this dust from being carried back to the gun.

As in the case of the firing ranges, heated air is admitted to the firing room and also to the space between the firing room and the intermediate partition. Although the rate of air change must be ample, less air is required than for the target ranges, since the distance from gun to the stop is much less. Air is drawn through the firing room port at a velocity of not less than 400 to 450 fpm, through the opening in the intermediate partition at 500 fpm or more, and removed from the enclosure in front of the stop through an opening located in the side wall near the ceiling.

Before being discharged to asmosphere, the exhaust air should be passed through a suitable dust collector; one of the centrifugal type can be used satisfactorily. The exhaust fan itself must be of a type, design and construction that will stand up under the abrasive action of the grit.

(b) In connection with the pickle vats, the problem is one of condensation of warm acid vapors upon the cold surface of the vent pipe, the upper portion of which is outside the building. The pickle used is dilute sulphuric acid and the fumes are handled by an exhaust fan, the motor of which is located outside of the duct.

The problem itself is no different from that presented under similar conditions by any plant using dilute sulphuric acid pickle, but, owing to government restrictions on the use of certain materials, the solution may become difficult. Internal gutters at the base of the stack, with drain lines returning the condensed vapors to the tanks, will prevent dripping of condensate from the stock and hoods.

It is to be noted that, while the bath itself is dilute acid, the fumes are not—in fact, they may be highly concentrated, as the acid anhydride is given off at a

much higher rate than the water vapor.

Lead, or lead-coated metal, is the accepted material for the service but the former not only requires a large amount of lead (too much, under existing conditions) but is of questionable utility for the construction of weatherheads, ventilators, and the like, and the lead-coated devices may not be obtainable in prefabricated form.

In some cases, a lead coating applied to the metal by the spray process has been used, apparently with satisfactory results. This coating, however, must be very carefully applied and should be of adequate thickness. One-sixteenth inch or more seems to be indicated.

There are a number of acid resistant coatings on the market suitable for various conditions, but if such are used the conditions of service should be clearly stated and a positive guarantee as to their durability obtained from the manufacturer.

In connection with this protection, the fans themselves must not be forgotten. The protective coating on fan wheels should be applied by the fan manufacturer, and so called for in the specifications, as it is difficult for others to apply such coatings as lead spray without danger of unbalancing the wheel.

Air Conditioning

As is quite well known, various explosives are affected differently by the same atmospheric conditions; that is, some may be more sensitive when damp, others when dry. If then uniformity of results is essential, it is necessary that all fixed ammunition (that consisting of metallic cartridges) be fabricated under controlled conditions of temperature and humidity, both so regulated that the combination results uniformly in the desired characteristics. Furthermore, by proper control of the atmospheric conditions, the sensitivity of the materials can often be held at such a point as to result in a reduction of the working hazard.

For this reason, departments in which bulk explosives (those not in sealed containers) are handled will be required to be air conditioned, with the controls so arranged as to maintain the required conditions both summer and winter.

For the sake of economy, since adequate ventilation is required in all such locations, the air conditioning apparatus should be so designed as to provide for winter heating as well as summer cooling; and for the sake of safety and the prevention of the accumulation of dust the apparatus should be without any provisions for recirculation. The washing of the exhaust air has been described above.

Materials and Apparatus

While established custom has resulted in the use of certain materials for certain purposes, in many cases it has been because such materials were plentiful and were satisfactory for the service required of them. It does not follow that other materials cannot be used for the same purpose and that such materials might not be as good, or even better, for the service than the customary ones.

The various bulletins and directives issued by the War Department enumerate very definitely the materials on the prohibited list and also, in many cases, give a list of the substitute materials acceptable in their place. These substitute materials may or may not be actually available, either because of priority ratings or because of the unreasonably long time required for shipment, due to bottlenecks in production and to excessive demand resulting from the increased requirements for their use. The same situation may exist in connection with apparatus, with the manufacturer many weeks behind in deliveries.

The designer must bear in mind that, when completed, his design may very well show what he would like to use instead of what the installation will actually be. For that reason it may be well to avoid, except in cases of absolute necessity, the use of apparatus or materials which are without practical equivalents and which are of such design and arrangement that substitution without a major operation is not feasible.

The specifications, which are as much a part of the design as the drawings, should deal rather with typical materials and methods and with the desired results and should refrain from definitely calling for any specific material or piece of apparatus unless its use is indispensable beyond question.

It is not only desirable, but necessary, that the specifications make reasonable allowance for the scarcity of any given type of apparatus or material, the more so as such scarcity may easily develop after the specifications have been issued and during either the figuring or the construction period.

For these reasons, it is well to make clear, by the insertion of appropriate provisions in the specifications, the fact that legitimate, authorized substitutions are both allowable and acceptable.

The judicious use of such clauses may save arguments and delay and will clearly indicate to the contractor the requirements governing the use of substitute apparatus, equipment and materials and prevent attempts to obtain approval of unauthorized substitutions on the plea that what was specified was not obtainable.

Entranceway to a typical manufacturing building at a small arms munitions plant.

PART 2—NOTES ON A TYPICAL SMALL ARMS AMMUNITIONS PLANT

IT hardly need be said that, under the existing conditions and in view of the restrictions imposed by the Federal Government, any published data regarding a plant engaged in a war industry must necessarily be lacking in many items which would be of great technical interest.

If, therefore, the following description seems at times to be somewhat vague and sketchy and to take certain features or conditions for granted without comment or description of their exact nature, location and extent, it is hoped that it will be understood that the underlying reason is that in some cases it is impossible to talk at all without saying too much.

General

The description is in reality a composite one, based upon the construction of six fundamentally similar small arms munitions plants, located in various parts of the country.

The design and construction of all six plants was not carried on simultaneously, but rather in groups chronologically overlapping, the total time being somewhat over two years.

During that time, certain restrictions upon the use of various materials were imposed by the Federal Government and, as a result, substitution of materials had to be made in the field. The restrictions changed rapidly at times and the use of some materials for certain purposes was, ultimately, entirely prohibited.

In consequence of this condition, the same materials were not necessarily used consistently for the same purpose throughout any one installation and it would be impossible, without making a detailed check of the installation, to make any definite statement regarding the materials actually used.

While, in general, the lists of restricted or prohibited materials authorized the use of certain definite, substitute materials, in many cases several allowable substitutes were mentioned and, for that reason, the specifications required that all substitute materials be subject to the approval of the government officer in charge of the project.

Hazardous Areas and Locations

In order to indicate the conditions which exist as a result of the storage or the handling of explosives or highly inflammable substances, the terms *hazardous area* or *hazardous location* will be used; the former to designate the general vicinity and the latter a particular portion of a hazardous area.

It is naturally desirable that all hazardous areas be separated from other portions of the premises as completely as possible, that all communication between hazardous and non-hazardous areas be as indirect as possible and that all apparatus and equipment installed in hazardous areas be of such a type and design as not to introduce any additional risk by its presence or by its operation.

For that reason, all electrical equipment and ap-

paratus must be of the explosion-proof type and non-ferrous materials must be used for ductwork, piping and other parts of the system which, in their normal operation or by accidental impact, might produce a spark. In addition to these precautions, all metallic apparatus and equipment is thoroughly grounded.

Steam System

In hazardous areas, where the use of steel piping is not permissible, non-ferrous piping is used. This, in general, is type L medium weight hard copper tubing, put together with solder-joint fittings, the type of solder used being as required by the temperature.

In other locations, the piping is of steel, the joints in sizes 2½ in. and larger being welded, except at valves, apparatus connections and elsewhere where other types of joint are required. Valves are either flanged or screwed, according to size, and in the case of screwed valves, a union is installed adjacent to each. Flanged unions for high pressure piping are made up of pipe flanges and are not the standard flange unions.

Pipe sleeves in hazardous locations are non-ferrous; in other locations, steel. For use in masonry construction, sleeves consist of standard pipe, of the size required, cut to length. In frame construction, prefabricated telescopic sheet metal sleeves are used.

Where necessary to insure the thorough separation of adjacent areas by wall, partition or floor, the space in the sleeve around the pipe is packed with asbestos rope held in place by wall, ceiling or floor plates clamped to the pipe. In some cases, the sleeves are of sufficient size to permit the covered pipe to pass through; in other cases, the bare pipe only, is enclosed.

Since steam is required for process purposes at a pressure above that normally required for heating system supply, the general distribution in the buildings is at the highest pressure required with, of course, allowance for pressure drop, as some of the runs are rather long. Lower pressures, where required, are obtained, where possible, by means of *flash steam*, as described below, supplemented by the use of pressure reducing valves of the single seat type.

As this implies, there may be—and in a number of cases are—several different steam pressures in one building.

Flash Tanks

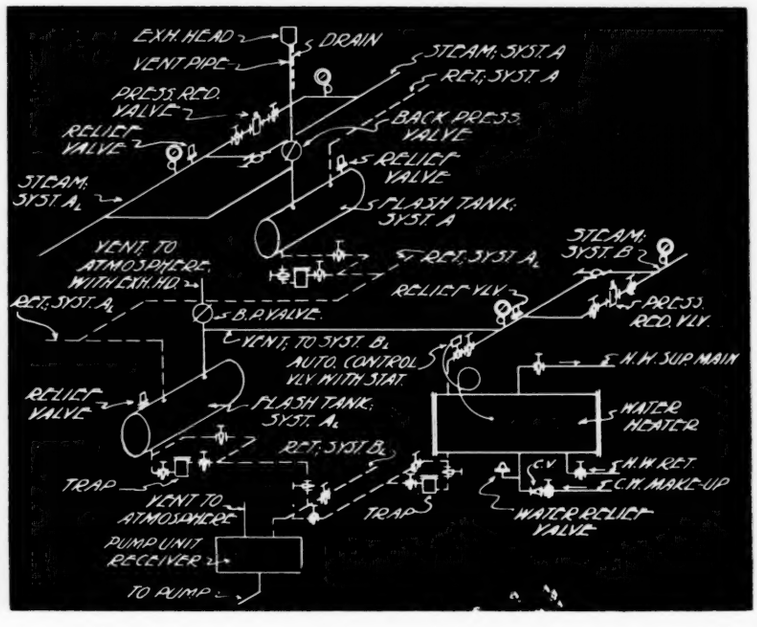
With a number of different steam pressures carried severally in different parts of the steam distributing system, it follows that the corresponding portions of the return system will also be subjected to different pressures. In order to avoid the complications of a multiplicity of separate return systems, it is necessary that the pressure in the various branches be equalized. This is accomplished by means of flash tanks.

Below is a typical diagram showing the arrangement of the flash tank connections.

Wherever possible, the arrangement is such that the pressures are progressively stepped down, utilizing when feasible the flash steam as supply to the steam system of the next lower pressure and trapping the condensate from the tank into the corresponding return system.

As the amount of flash steam from any one flash tank is necessarily variable, make-up steam is supplied through a pressure reducing valve so adjusted that it will pass steam only as make-up, should the available quantity of flash steam be insufficient to maintain the pressure at the desired point. This arrangement is stabilized by means of a back-pressure valve set to relieve at about two pounds above the pressure for which the reducing valve is adjusted, so that the pressure in the system utilizing the flash steam will vary from that for which the pressure reducing valve is set (as a minimum) to that at which the back-pressure valve will relieve (as a maximum).

It is desirable that this pressure range be kept within as narrow limits as possible, so as to avoid



Schematic diagram of typical flash tanks and connecting piping. This system serves to equalize several different return pressures.

undue fluctuations in pressure in the receiving system; but the adjustments must be such that, under any conditions of normal operation, neither the pressure reducing valve nor the back-pressure valve will chatter and so that the minimum amount of steam will be wasted through the back-pressure valve.

In addition to the back pressure valve, each flash tank is provided with a relief valve of capacity adequate to prevent the pressure in the tank from building up beyond the maximum pressure permissible in the system into which the flash tank is vented. To insure this result, the relief valve is set at a pressure slightly below the maximum allowable pressure in the receiving system. This relief valve discharges inside the building so that its function is two-fold: (1) to provide an ultimate safety relief for the protection of the apparatus and equipment on the receiving system in case the back-pressure valve should fail to function; and, (2) to serve as an alarm signal and call attention to the failure of the back-pressure valve to operate.

Such an arrangement may seem like a redundancy of reliefs, but the writer's experience has been that any relief (or back-pressure) valve which is subject to fluctuating pressures will emit puffs of vapor from time to time and, if the installation be in a climate subject to temperatures below freezing, these puffs may freeze in any portion of the vent pipe which is outside the building and may eventually bridge it over with the resulting accumulation of ice and ultimately effectively seal the end of the pipe. This is no theoretical deduction; it has actually happened in several cases within the writer's experience and can, very easily, happen again. Increasing the size of the vent pipe is no certain remedy; the writer has found 4 in. and 5 in. relief valve vents (discharges) completely sealed with inch-thick ice.

To return to the flash tanks. While, in general, the lowest pressure flash steam is vented into the water heater supply, in some cases the flash tank connected to the system of lowest pressure has been vented to atmosphere and has been arranged to serve also as a condensate receiver, or surge tank, and is provided with a float control to regulate the flow of condensate which is discharged from the tank into the return pump receiver. The float control is of the usual type, consisting of a float valve in the discharge pipe from the tank, actuated by a float in a float chamber which is connected to the tank by piping. Some of the tanks used for this purpose are of such a size that the difference between high and low water level exceeds the range obtainable with a single float of standard design. To overcome this difficulty, such tanks are provided with two float chambers and floats; one to operate the mechanism at high water level and the other to function at low water level.

Condensate Return Systems

After being reduced to low pressure in the last flash tank, the condensate, which may then be at any pressure from atmosphere to 10 lb gauge, depending upon the particular requirements, passes through a trap and is returned to the boiler by gravity flow, return pump or vacuum pump, the means employed in any particular case depending upon the extent of the system and other usual considerations.

In some cases, a certain amount of steam has been unavoidably so utilized as to be incapable of being returned as condensate, but the quantity of steam so used has been kept as low as is consistent with the requirements. This economy is desirable on account of the hardness of the available water supply which, in the average case, is of a rather high degree and, in some cases, exceeds 15 grains per gallon. For uses for which hard water is objectionable, such as boiler feed and certain process work, the water must be chemically softened and, therefore, is not to be unnecessarily wasted.

In some locations, where the quantity of condensate is sufficient to justify the installation of such equipment, the returns are passed through an economizer type of water heater before being discharged into the pump receivers.

Heating

The heating is by means of direct cast iron radiation, convector heaters, unit heaters or hot blast, as required by the location; the latter two methods being used for the larger areas and where ventilation is required. In a few cases, in small, isolated areas, gas-fired unit heaters were used. Needless to say, only strictly non-hazardous locations can be so served.

Direct radiation is used, in general, in the offices

(Left) DeBothezat roof ventilators remove heat and exhaust fumes from bullet case washers in one of the manufacturing buildings. (Right) Air-Van power ventilator in foreground exhausts hot waste gases from mouth and neck annealers. DeBothezat unit in upper background exhausts from bullet case washer.

and is of the cast iron, low pressure, wall-hung, legless type.

Convector heaters are used in the industrial areas, in the smaller spaces. They are of the high pressure type, fin-tube or plate-fin pattern, and are provided with suitable covers with grilles and shield, as required. In hazardous locations, this radiation is of non-ferrous materials. Aside from the use of non-ferrous enclosures and accessories in hazardous locations, the radiation used presents no unusual features.

Unless local conditions require otherwise, the steam supply to unit heaters is at the highest distribution pressure and the general installation is of the usual type. The heaters themselves are of the blower, projection or propeller fan type, as required, depending upon the conditions imposed by the nature of the operations and equipment.

Projection type heaters are provided with adjustable diffusers of the cone type.

In locations where blower type heaters are arranged to handle outside air and are used for purposes of ventilation, they are provided with air filters and, if so required for the distribution of air, discharge through a simple duct system. Except in hazardous areas where any accumulation of dust is to be avoided, these units are arranged to provide for the recirculation of air.

The filters are, in general, of the throw-away cell type with non-combustible filter medium although, in some cases, fabric filters, Class A-1 Underwriters' rating, were called for.

The controls of the unit heaters are automatic. Heaters which recirculate only, are provided with fan control, the thermostats being arranged for manual setting for on, off or automatic control. The transfer device may be either integral with the thermostat or separate therefrom, according to the type used.

When the intake connection to outside air is provided, the recirculation, if any, is manually controlled; the remainder of the controls are automatic and are of the type and arrangement customarily used for supply fan units, with the necessary valve and damper control, supplemented by a limitstat in the discharge duct, which controls the steam valve of one section of the heater coil.

Ventilation

Ventilation is provided, where required, for the purpose of air circulation or air change only. Air conditioning, which is separately described below, is not installed for comfort cooling but only where required in connection with industrial processes or by the nature of the material handled.

In hazardous areas where the use of steel is not permissible, duct work, heater casings and other sheet metal work is of non-ferrous material. In other locations, steel sheet protected by suitable coating is used.

Originally, the material used was galvanized steel, but restrictions later imposed upon the use of zinc caused the use of bonderized metal or metal coated with lead, asphalt, or other protective material, as a substitute. In some cases, ducts were made of transite, or other similar material.

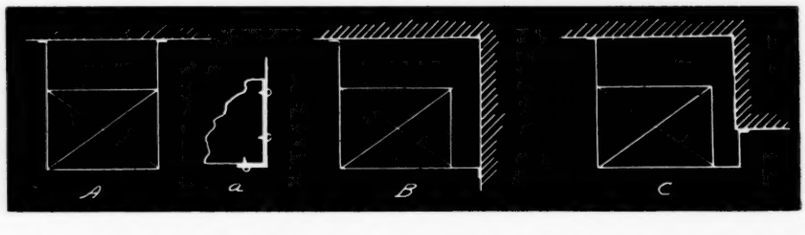
Where copper or brass is joined to a dissimilar metal, adequate protection is provided against contact of the two metals, in order to guard against possible electrolytic action. In such cases, all bolts, rivets, screws and other fasteners are of the metal which wou'd form the positive of the electric couple and are carefully insulated from contact with the negative metal. In the case of a copper-galvanized steel combination, for example, the fasteners would be copper.

With the above mentioned exceptions, the sheet metal work is of the usual construction and arrangement, using square elbows and right angle branches for rectangular ducts, with deflecting vanes of the area-compensating, or constant velocity, type.

Flexible connections are provided at all joints between duct work and apparatus. These are, in all cases, made of heavy asbestos cloth.

Gravity type roof ventilators receiving the discharge of exhaust fans are provided with dampers interlocked with the fan motor circuit so that the starting of the fan automatically causes the damper to open, and vice versa. For other service, the dampers are of the chain operated, weighted, butterfly type.

Goose-necks are used in some instances to serve either as fresh air (fan) intakes or for exhaust fan discharge vents. In either case, the dampers are automatic and are interlocked with the fan motor circuit, as above described. This control is either electric or pneumatic, actuated by an electro-pneumatic switch, depending upon its proximity to temperature regulation apparatus and the type of temperature regulation used.



Methods of sealing off air ducts to eliminate surfaces where powder dust might settle and create a hazard. Continuous sheets extend to the ceiling or nearest wall.

Temperature Regulation

The temperature regulation system proper, as distinguished from the control of the air conditioning apparatus and from the *on* or *off* controls of the unit heater fans, comprises the controls for the dampers and heater coils of the fan apparatus and also any controls which are required for direct radiation and convector heaters. All such controls are of the usual type and perform only the routine functions.

Air Conditioning

As above implied, in connection with certain processes, the control of both temperature and humidity is very essential since heat, cold and moisture, beyond certain limits, may alter the characteristics of the material handled to an undesirable extent.

The essential features of the air conditioning apparatus, using spray coil type dehumidifiers with dew-point control, are of the usual type, although a few refinements have been added where required. In all cases, the air conditioning system is arranged to accomplish winter heating as well as summer cooling.

With one or two exceptions when the climatic conditions, water temperatures, load conditions and other circumstances justified the omission of such apparatus, the cooling effect is obtained by means of mechanical refrigerating apparatus using Freon as refrigerant.

Fresh air intakes are sized upon the basis of handling all outside air.

Preheater and reheater coils are made up of sections of fin-tube, non-freeze coils, one row of tubes deep. Originally copper tubes were used, but in later installations, in conformation to Federal requirements, the tubes are of steel. Steam supply is at a nominal pressure of 10 lb gauge.

Dampers consist of (a) a shut-off damper in the fresh air intake; (b) a by-pass damper, in connection with the preheater coil, of sufficient area to permit the passage of 100% of the air handled by the fan and (c) a manually operated bypass damper in connection with the reheater coil. There is no bypass damper in connection with the dehumidifier.

The steam inlet to both the preheater and the reheater coil is provided with a graduated acting, thermostatically controlled valve.

The control of these valves and dampers is as follows:

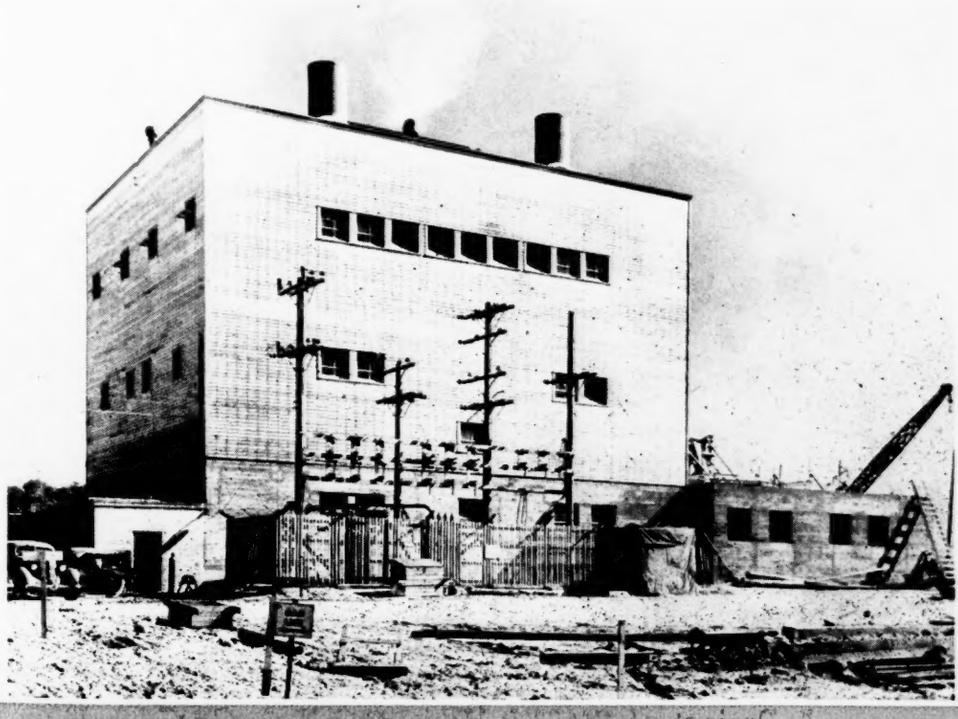
(1) A suitable switch, interlocked with the fan motor circuit to fully open and tightly close damper (a) when the fan is started and shut down, respectively;

(2) A dew point thermostat, located between the eliminators and the spray heads to control damper (b) and also the preheater coil steam valve;

(3) A hygrostat, suitably located in the conditioned area to control the steam supply to the reheater coil through a high limitstat in the fan discharge.

Should the conditioned area consist of more than one zone, a separate fan is provided for each zone and, also, separate reheater coils as required. The controls are modified to correspond.

The exhaust from areas in which the exhaust washer is not required is accomplished by means of power driven roof ventilators. The dampers in these ventilators are usually of the balanced, self-closing, louver type, although, in some cases, dampers of the motor driven butterfly type interlocked with the supply for motor circuit were used. The motors for all power driven roof ventilators are of the two-speed type and are provided with separate speed-changing switch.



Exterior view of a power house at a small arms munitions plant built almost entirely of wood because of restrictions on critical materials. An exactly similar unit at this same plant, completed before restrictions became so severe, is of the conventional steel and masonry construction.

THE TWIN CITIES

A SMALL ARMS MUNITIONS PLANT

By JOHN J. WOOLFENDEN

THE Twin Cities Ordnance Plant is, as the name implies, located in the St. Paul - Minneapolis district, in Minnesota. It is one of the more recent of the group of such small arms ammunition plants constructed within the past two years and while, for that reason, the heating and ventilating systems embody certain features which are the natural outgrowth of the experience gained in connection with the work on previous plants, it is also true that, owing to the restrictions imposed by the Federal Government upon the use of critical materials, the same freedom of selection of materials and apparatus that was possible in the case of some of the earlier plants did not exist in the case of the Twin Cities plant.

Type of Construction

The various buildings are distributed singly or in groups, as required, over an area of approximately four square miles and are of diverse types of construction, depending upon the nature of the operations carried on within them. The plant, as a whole, actually consists of two plants; one semi-permanent and one temporary. Since, as is usually the case with temporary plants, a limited operating life was contemplated, the building construction differs materially from that used for the plants of a more permanent nature and the use of critical materials has been avoided to a much greater degree than would otherwise be possible. In spite of this aspect, however, it is fully adequate to serve the purpose for which it is intended.

Heating and Ventilating

While such liberties could well be taken with the materials and types of building construction, the same is not true in the case of the heating and ventilating systems. In them, the substitutions are almost entirely (if not fully) those which have been adopted, generally, as war time standards; and they involve the elimination from the materials used of such metals as chromium, copper, zinc, aluminum, tin and other critical materials in all cases where their use is not fundamentally essential. Likewise ruled out is the use of ferrous materials except where nothing else which would serve the contemplated purpose satisfactorily is available. As in all things, there is a certain minimum below which one cannot go without sacrificing safety. On the other hand, there are also some items in which the element of safety, while by no means of minor importance, becomes less prominent, in that it is adequately taken care of by the strength of the standard weight of the materials obtainable. In the long run, it is a matter of common sense.

Perhaps as good a way as any to give an idea of the magnitude of the project is to list a few of the over-all quantities of materials.

Water pumped per day, approximately	8,500,000 gal
Steel pipe inside buildings, approximately	160 miles
Pipe covering, approximately	117 miles
Pipe nipples, total	183,000
Valves, total	64,040
Total boiler capacity, maximum, approximately	15,000 bhp
Total refrigerating capacity equivalent (Air Conditioning systems) more than	1,100 tons

Steam is generated at high pressure and is reduced to 90 lb pressure for distribution in the buildings. It is used at that pressure for process purposes and for supply to the unit heaters and high pressure radiation. A further reduction to 10 lb gauge is made for the supply to the blast coils, water heaters and low pressure cast iron radiation.

The heating systems are of the two-pipe gravity return type, although condensate return pump units are provided in the larger buildings in which the load is heavy, due to the ventilating or air conditioning requirements.

Unit Heaters

All three of the fundamental types of unit heaters are used; viz., blower type; projection or vertical type, and propeller fan type. The blower type heaters are of the V-belt driven design.

The largest heaters of the blower type are provided with fresh air intakes, air filters and manually operated dampers. In general, these heaters are ar-

ORDNANCE PLANT

AT ST. PAUL, MINNESOTA

Engineering Staff Smith, Hinchman & Grylls, Inc.

ranged to permit of recirculation and the mixing of the outside and the return air in the inlet chamber. A number of them, however, located in areas where explosives are handled, are arranged to take in outside air only, at a minimum temperature of —30F.

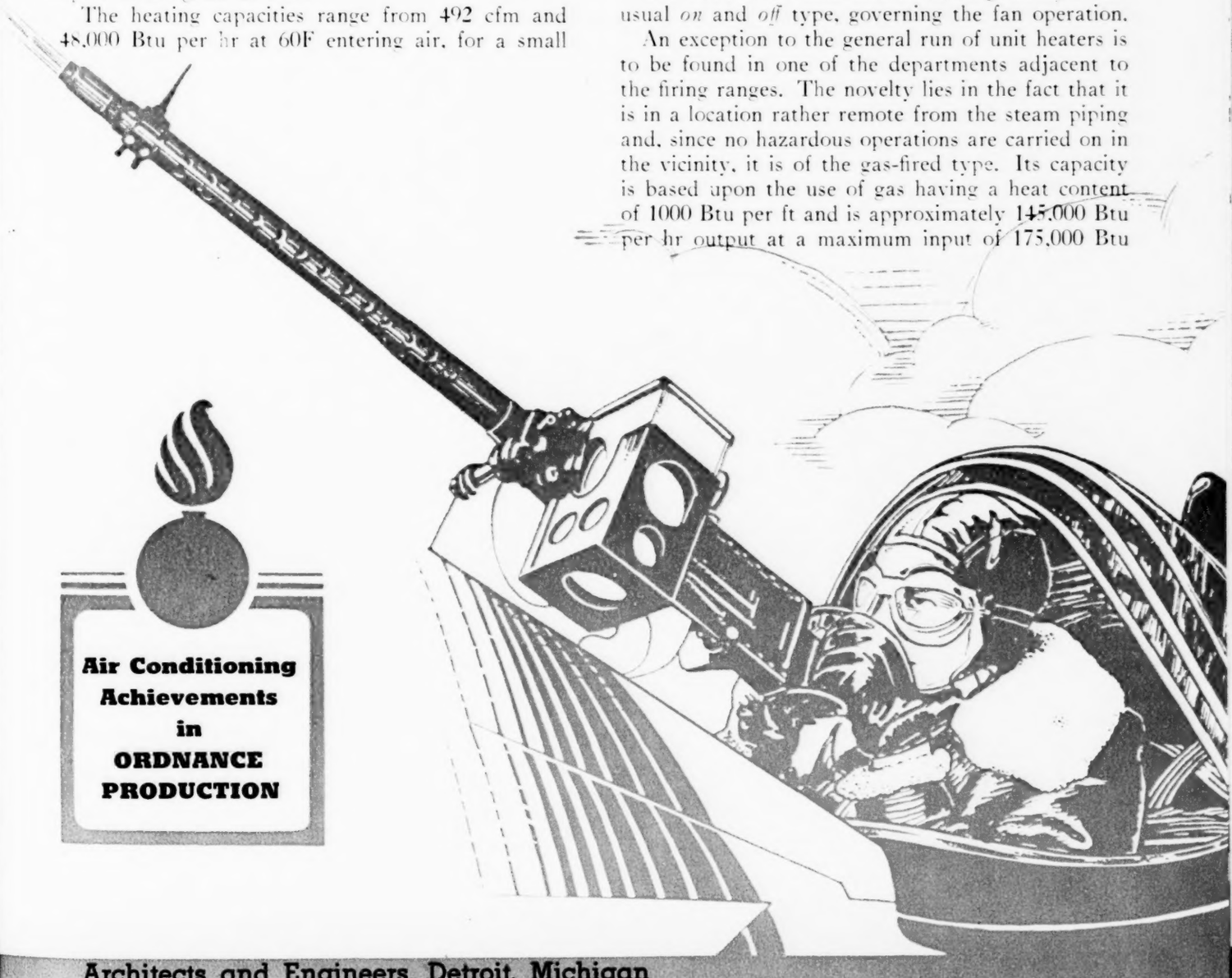
The final temperature of the air leaving the heaters, under the specified conditions, ranges from 138F to 155F, with an average value of 144F. With the exceptions above noted, the capacities are based upon entering air at 60F.

The heating capacities range from 492 cfm and 48,000 Btu per hr at 60F entering air, for a small projection type heater, to 4600 cfm and 822,000 Btu per hr at —30F entering air, for a large heater of the blower type.

The heaters in hazardous locations are provided with non-ferrous fan wheels, and all electrical equipment such as motors, starters, and switches in connection with them are of the dust-tight, or explosion-proof, type. The other heaters are of standard construction.

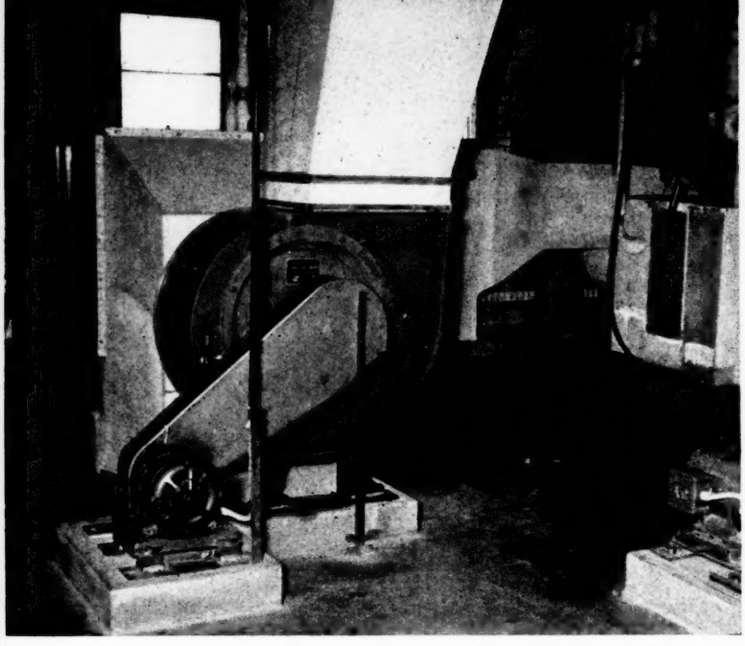
The control for unit heaters is, in general, of the usual *on* and *off* type, governing the fan operation.

An exception to the general run of unit heaters is to be found in one of the departments adjacent to the firing ranges. The novelty lies in the fact that it is in a location rather remote from the steam piping and, since no hazardous operations are carried on in the vicinity, it is of the gas-fired type. Its capacity is based upon the use of gas having a heat content of 1000 Btu per ft and is approximately 145,000 Btu per hr output at a maximum input of 175,000 Btu



Air Conditioning Achievements in ORDNANCE PRODUCTION

Architects and Engineers, Detroit, Michigan



Supply and exhaust air conditioning equipment in tracer wing. A Clarage spray fan, driven by Allis-Chalmers motor, is shown in the foreground.

per hr, with a fan capacity of approximately 2500 cfm, a final air temperature of 92F, and with entering air at 38F. The control consists of a remote control gas valve with the necessary accessories for actuation.

The fan equipment consists of the necessary supply and exhaust units, and with this apparatus there should be included two unit heaters which are actually prefabricated ventilating units, and also the power driven roof ventilators.

One of these unit heaters is used for the supply of tempered air for ventilation only. Its capacity is about 3770 cfm against ⅞ in. resistance pressure. The tempering coil is of the non-freeze type with a capacity to heat the air handled from —30F to 84F, with steam supply at 90 lb gauge. This heater is provided with an integral filter section. The return air mixing damper is manually operated, while the fresh air intake damper is interlocked with the motor circuit through an electro-pneumatic switch. This heater discharges through a simple duct system.

The control for this heater consists of a modulating type thermostat in the fan discharge arranged to control the tempering coil steam supply valve.

The other unit heater is located in one of the repair shops and is used for both heating and ventilation. It is of large capacity (10,000 cfm at 123F final temperature, with entering air at —30F) and is provided with manually operated recirculating damper, fresh air intake (shut-off) damper interlocked with the motor circuit, an air filter consisting of nine 25 x 20 x 2 in. thick throw-away type cells in V-form.

Heater Controls

The steam supply to this heater is controlled by a thermostat located in the discharge duct, which also performs the functions of a limitstat. In conjunction with this there is an auxiliary control consisting of a room thermostat arranged not only to control the steam supply but also to stop and start the fan motor. This latter function is optional and may be rendered inoperative, at will, by means of a manually operated switch.

The intake (shut-off) damper can be operated, only when the fan is in motion, by means of a manual switch. This switch has no control when the fan is not running.

These controls are all of the electric type, as there is no compressed air available at the apparatus location.

Firing Range Ventilation

A word regarding the ventilation of the firing ranges may be of interest. There are, in all, seven units, of which four are for supply and three are for exhaust purposes. The total capacity of the supply units is approximately 20,000 cfm and that of the exhausters 22,600 cfm. Of these quantities, the greater portion is required by the ranges proper, the balance being for the ventilation of certain auxiliary rooms used in connection with the operations.

The total steam supply to the structure housing the ranges is about 8100 lb per hr maximum, of which about 1600 lb is for water heating.

The blast coils are of the non-freeze type and are all two tubes deep, one stack wide and one stack high. For the ranges proper there are two banks of coils for each fan unit. These coils are on the discharge side of the unit, the duct being divided into two branches. Each branch may serve one or more ranges. The aggregate face area of these coils, for all supply units, is slightly over 23 sq ft.

The other fan apparatus is of the usual type, the principal departure from standard construction being the use of non-ferrous parts and explosion-proof electrical apparatus, where required.

Ductwork

As might be expected the ductwork is constructed of various materials, including galvanized sheet steel, lead-lined galvanized sheet steel, masonite, transite and wood. The first two named have been used only where necessary, the ducts in general being made from the latter three.

An interesting problem in duct construction was presented by the fume vents at the pickle vats, or *barrels*. Some of the vapor given off is water vapor, while the remainder of it has a very appreciable acid content.

The fumes from these vats are collected by hoods, located above them, these hoods being connected by ducts to the respective vertical stacks which run through the roof. The fumes are removed by gravity circulation.

In all cases, the vertical stacks through the roof are of wood, while the hoods and the connecting

ducts are either of masonite or of transite; the former being used where water vapor only is to be handled and the latter, for fumes which have an acid content. In each case, the hoods and ducts have been treated with a suitable protective coating.

However, since fumes from a dilute acid are usually much higher in concentration than the solution itself, considerable trouble was experienced through their action on the hoods and ducts. It was not until a slight modification of the process, itself, was instituted which resulted in a marked reduction of the acid content of the vapor, that this trouble was overcome.

Air Conditioning

As in all other similar plants, certain of the operations carried on require air conditioning for the proper control of the process. There are several air conditioning units provided for the purpose, each so arranged as to be capable of performing the dual function of winter heating and summer cooling.

These units are of various capacities and, in general, of two types: the one obtaining the refrigerating effect by means of the usual refrigerating compressors, spray-coil dehumidifier, and so forth; and the other making use of a spray or air washer type dehumidifier using the evaporative effect for cooling. The controls are of the pneumatic type. All fans in connection with these units are provided with volume control at the inlet by means of dampers of the vortex type. The refrigerating compressor control is arranged to automatically start and stop the compressors and to operate as a high-low control with a maximum reduction in capacity of 50%.

Outside air conditions for summer are taken as 95F dry bulb and 75F wet bulb and for winter as —20F dry bulb.

A water heater is provided in connection with the air washer type dehumidifiers for tempering the spray water.

In the case of the units using refrigerating compressors the coil control is by means of face dampers on each side of the preheater and the reheater coils, so arranged as to be capable of shutting the coils off, completely, from the air stream. These dampers, thermostatically controlled, function in connection with a by-pass damper, linked in reverse, so as to operate as a mixing damper. The steam supply to the coils is manually controlled.

The other units are provided with thermostatically operated valves on the steam supplies to the coils. A by-pass is provided in connection with the preheater coil.

Return air dampers are manually operated in all cases.

The air conditioning installation installed in the tracer manufacturing shop is arranged for circulation, so that instead of discharging all the air from the room to the outside of the building, the return air or any portion thereof can be reclaimed and reused.

PROJECT ADMINISTRATOR

Paul J. Ketelhut, Project Administrator at the Twin Cities Ordnance Plant for the architects and engineers. A graduate of the University of Michigan College of Architecture, he has been identified in various capacities with Coral Gables; Michigan State Prison; and various projects of the Home Owners Loan Corporation, and the State of Michigan.

A false ceiling has been constructed above the space occupied by this department and the space above this ceiling has been suitably divided into two plenum chambers; viz., a supply air plenum and a return air plenum.

The supply fan discharges into the supply air plenum whence air is admitted to the working space through suitable openings.

The dust producing operations are conducted on benches under hoods, and ducts from these hoods run up through the supply air plenum to the return air plenum.

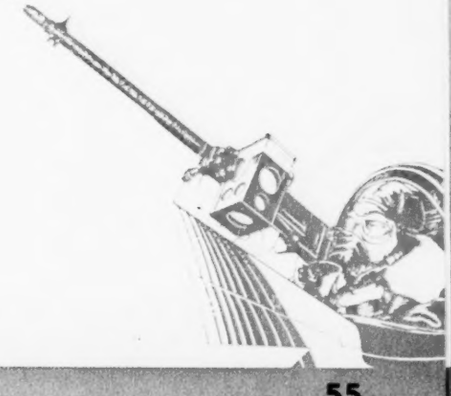
Part of this return air is mixed with the desired quantity of fresh air and drawn by the fan through the air washer, which is on the inlet side of the fan. The apparatus thus handles a mixture of fresh air and return air.

All ducts are constructed of galvanized sheet steel and are provided with tightly fitting access panels held in place by bolts with wing nuts. These panels are sufficient in number so that every inch of the inside of the ducts can be examined and cleaned.

The return air plenum chamber is constructed of concrete and masonry and is waterproof. The floor is pitched to a sump adjacent to the air washer and this sump in turn drains to a separating sump outside of the building.

Means of extinguishing fire in the return air plenum are provided in connection with the fire protection system and hose bibbs are provided for attachment of hose used in washing down.

The successful operation of this system is a matter of scrupulous cleanliness and in order to insure against a lapse, the return air chamber is thoroughly washed out at regular intervals, at least three times in every twenty-four hours.



DICKSON

SOLVES HIGH HEAT RELEASE

By RAY W. TUER

Chief Mechanical Engineer
Shreve, Anderson and Walker

For the past seven years Mr. Tuer has been with Shreve, Anderson & Walker as head of the mechanical engineering department. Prior to that, he was assistant to the plant engineer, Leonard Division of the Kelvinator Corporation. A registered engineer, he attended the University of Michigan School of Engineering. Among the outstanding projects designed under his supervision are ordnance plants for the Army and Navy; Internes' Quarters Building at the University of Michigan; and a hospital and other buildings for the State of Michigan.

Air Conditioning Achievements in ORDNANCE PRODUCTION

A Project of SHREVE, ANDERSON AND WALKER

GUN PLANT

PROBLEMS IN HEAT TREATING DEPARTMENTS

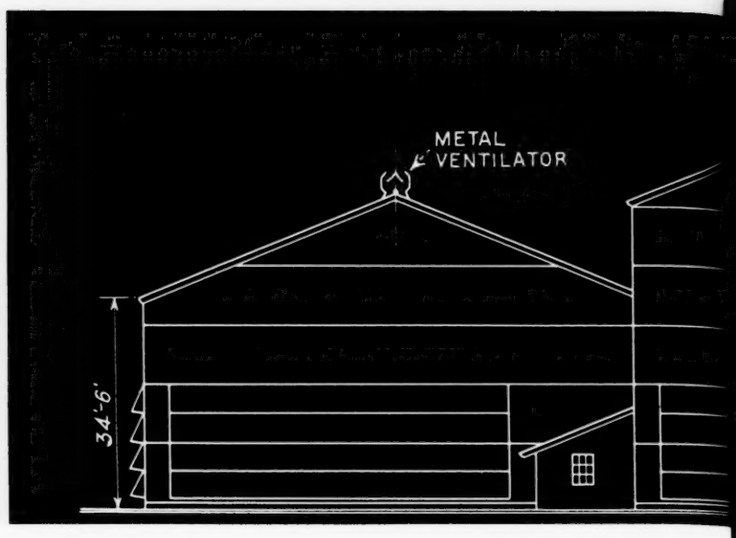
WHEN the Government developed its armament program, just before Pearl Harbor, several plants for the manufacture of guns were included in this program. Some of these plants were to manufacture guns by a process developed at the Watertown Arsenal. The Dickson Gun Plant, located in the vicinity of Houston, Texas, and operated by the Hughes Tool Company, a concern well known in the oil industry as manufacturers of drilling equipment, is one of these. While it would seem a long step from the manufacture of well drilling equipment to the manufacture of guns, this company's many years of experience in machine operations and heat treating processes similar to those required in the manufacture of guns, make it well-suited for the job.

This plant produces gun barrels by the unique centrifugal casting method developed by the U. S. Army Ordnance Department, a method requiring a considerable amount of special equipment and one capable of producing more and better guns than do the older methods. This method has been applied to much of the light and medium artillery pieces. The melting is done in specially designed induction type furnaces in which the furnace coils and crucible are carried in the same frame. The power for the furnaces is supplied by special high frequency motor generator sets, one for each furnace. The naturally low power factor of this type equipment is corrected by the use of banks of water cooled capacitors. For each casting the furnace is charged with bar stock cut to length and of just sufficient weight to cast one gun barrel. There is no flame and very little smoke during the melting operation; when the current is turned on, the charge turns red, then white, and then melts. When the charge is melted and the furnace additions have been made, the furnace is disconnected and transferred from the melting platform to a pouring car which is accurately set in relationship to the casting machine. This pouring car is used to tip the furnace into the pouring position and to control the rate of pouring so that just the proper head can be maintained on the pouring box which is carried on the pouring car and controls the rate at which the metal is cast. The mold in which the casting is made is carried and rotated by a large horizontal centrifugal casting machine which operates at a specific speed for the individual gun being cast. This speed is a very important factor in the final casting. After the casting has set, but before it has lost its color, it is removed from the mold and put into a cinder pit to cool.

After cooling, the casting is carefully inspected and tested and if satisfactory, it is given a preliminary normalizing heat treat, done in one of the many large double-end car type direct gas-fired high temperature furnaces. After the necessary period of heating and soaking, the casting is allowed to cool in the air and is then charged into one of another battery of large single-end car type furnaces similar to the first except that the furnace temperature is different. Here it is heated, soaked, and allowed to furnace cool. Upon completion of this operation it is again inspected and tested.

If the casting is found to be satisfactory at this point it is transferred to the machine shop for rough machining operations which give the casting the approximate size of the finished barrel. These operations include straightening, turning, and boring, and are performed on a large number of specially adapted engine lathes, boring lathes, deep hole drilling machines, special gun lathes, and straightening presses. The machining operation takes considerable time since it is this operation which will determine, to a large extent, the accuracy of the gun.

When the machining and straightening are completed, the gun barrel is given the final heat treatment necessary to develop the high physical properties required by the standards of the Ordnance Department. While all of the operations up to this time have been performed with the gun barrel in the horizontal position, the final heat treat is done with the gun in the vertical position. The furnaces used for this operation are large vertical batch-type direct-fired gas units with bi-parting motor operated covers. For proper operation the gun barrels must be well down into the furnace and yet can not touch the bottom of the furnace. One can well imagine the problem of handling involved since some of the castings are over 20 ft in length at this stage of manufacture. That is, to up-end a 20 ft gun barrel weighing some 5000 lb, hang it on a suspension piece, and place a batch of these guns into the furnace so that they do not touch the bottom—and are well below the top of the furnace—requires a lot of clearance from the furnace to the top position of the crane hook. It is interesting to note that the hangers used in suspending these guns in the furnaces have been known to elongate as much as 3 ft in their lifetime.



End elevation of the Foundry Building at the Dickson gun plant. The large heat release from powdering operations and heat treating furnaces creates a chimney effect in the building drawing air in through the wide louvers; fumes and heat escaping through metal ventilators.

When the barrels have been heated and soaked the proper length of time, the batch is removed from the furnace and quenched in a vertical water tank. The water in these quench tanks is kept at the proper temperature by circulating it through a cooling tower. The quenching operation is followed by a drawing operation in furnaces which are duplicates of the other vertical furnaces.

Tests and analysis are made between the major operations to assure that the guns being produced will be satisfactory. These tests consist of a chemical and spectrographic analysis of the furnace melt; a macrographic etching and inspection of a cross section of the casting at both ends of the casting; and a physical tension and Brinell test made after the heat treatment on a section taken from each end of the casting.

In addition to the manufacture of the gun barrels, this plant is also arranged to recover the metal taken from the casting in the machining operations. These turnings and borings are taken to a cleaning and briquetting building in the plant where they are washed, dried, and briquetted. These briquettes are in the form of discs about 5 in. in diameter and 3 in. thick. The briquettes can be charged into the melting furnaces along with the bar stock and cut up castings.

The plant consists of the non-productive buildings group of such buildings as the Administration Building, Laboratory, Personnel Building, Fire and Police Station, Warehouse, Maintenance Building, Briquetting Plant, and so forth; and the production buildings group made up of the Steel Foundry, Machine Shop, and the Heat Treat Buildings.

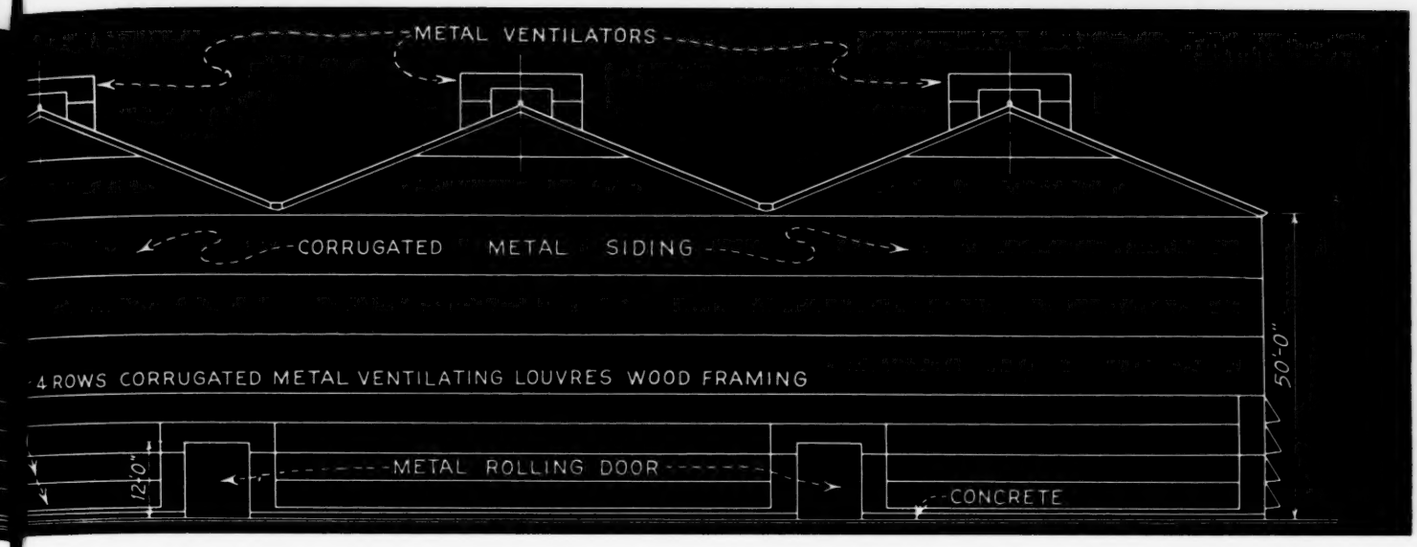
The Administration Building, Laboratory, Personnel Building and Fire and Police Station are of the single story frame construction type with the exception of the Administration which is of two story construction. The balance of the buildings in the non-productive group are of corrugated sheet metal on wood frame, except for the Maintenance Building which is constructed of corrugated sheet metal on a structural steel frame.

The production buildings are all constructed of corrugated sheet metal on a structural steel frame.

The plant is so arranged that the flow of materials is progressive from the receiving end through to the finished product. Material handling within the buildings is by overhead cranes, and between the buildings it is by factory trucks and lift trucks. Outside storage with overhead cranes is provided wherever possible to eliminate the cost of providing building space sufficient to care for it.

All buildings in the plant are set clear of the fences as an aid to plant protection. Because of this arrangement all entrance to the plant is through definite gate openings, making it impossible to by-pass the guards.

In common with all other plants being constructed during this war period the design of the buildings was definitely modified by the materials available, the critical materials list, and the priorities system. The engineers and architects were instructed to design the plant for a life of five years. This, together with the special conditions which had to be met, made the heating and ventilating of the buildings a very interesting problem. Some of these problems were made more severe by the climatic conditions



prevalent in the Houston area, such as summer temperatures which range over 100F with high relative humidity, and winter temperatures which go as low as 17F. It was also necessary to incorporate blackout features in the design of the buildings.

Because the material is handled by overhead cranes, the permissible temperature rise was established at not over 15F in the worst locations and not to exceed 10F elsewhere. Even then the crane operators will not be too comfortable when the temperature rises to the 100F mark.

Perhaps the most serious problem encountered was the high heat release from the various processes into the manufacturing space. For instance, in the steel foundry with its 172,800 sq ft of floor space, there is a heat release of approximately 210,000,000 Btu's per hour from equipment occupying 100,000 sq ft of floor space. This amounts to some 1200 Btu per sq ft per hr basis of the larger floor area and does not include the pick-up from motors, lights, and sun effect. On the basis of the smaller floor area, this figure runs up to 2100 Btu per sq ft per hr.

The heat treating building is another location in which the heat release runs much above a normal figure. This building has a floor area of 86,000 sq ft. The heat release in the building is 25,000,000 Btu per hr in a space occupying only 12,000 sq ft of the floor space. This averages 290 Btu per sq ft per hr based on the large floor area, and 2100 Btu per sq ft per hr on the smaller floor area.

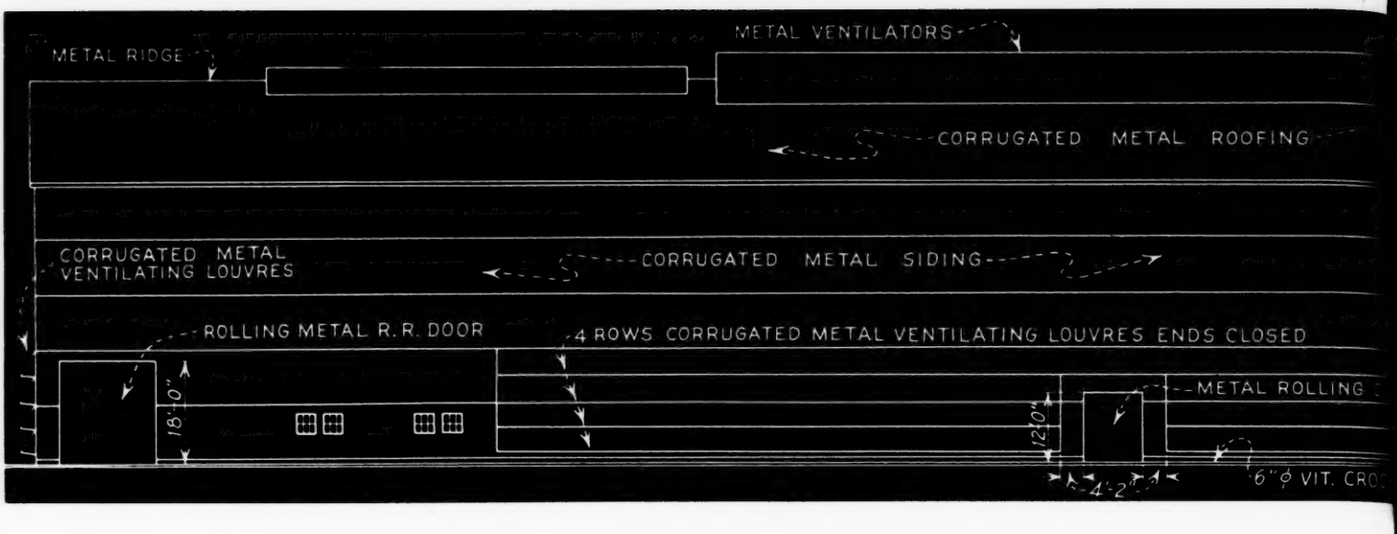
The machine shop, while it has a large number of heavy electrical motors, has no other great amount of heat given off in process with the exception of one recirculating type heat treating furnace that operates intermittently.

To limit the temperature rise of the air in the steel foundry and heat treat to 15F, air volumes of 12,500,000 cfm in the steel foundry and 1,560,000 cfm in the heat treat building are required. In terms of air changes this is 80 per hr in the steel foundry and 16 per hr in the heat treat.

In normal times the usual design for such a ventilating system would, in all probability, be based on using a forced air supply to the working areas and an exhaust system employing hoods over the furnaces and other large heat sources with power driven roof ventilators over the other areas. But since practically all of the materials for such a system are listed as critical materials, the ventilating was installed as described in the following paragraphs.

Probably the most important location requiring ventilation is the motor generator room in the steel foundry. This is the heart of the operation and the equipment contained in this room would be difficult to replace. This equipment is partly air-cooled and must have a definite air circulation. For this reason, large inlet louvers and an air shaft were provided to supply fresh air to this room which is below normal grade, arranged so that the air sweeps over the room from the supply inlet to two large 6 ft exhaust fans with bucket type wheels which discharge this air through an exhaust air tunnel to the out-of-doors. This air tunnel is located underground to conserve floor space and eliminate any interference with material handling. The smaller rooms off the motor-generator room are ventilated by the use of small disc type fans which force air from the large room into the smaller rooms. The exhaust air from these smaller rooms is allowed to escape through grilles into the far end of the large room near the exhaust air tunnel.

The main manufacturing areas of the steel foundry and heat treat buildings are ventilated by means of multiple heat valves extending the entire length of the building. Over the parts of the building where the heat is concentrated, the units are doubled up to provide more outlet area. These units are of blackout design and are equipped with dampers. The machine shop and maintenance buildings are similarly ventilated except single heat valves are used instead of the multiple type. With this type of ventilation it is generally considered necessary to provide inlet



areas equal to approximately one and a half times the throat area of the ventilator. To provide the necessary fresh air openings, louvers are installed in the outside walls around the entire building. These louvers were built on the job as part of the building and are designed to have sufficient overhang to trap the glare from the furnaces and safety lights during the black-out periods.

To give the crane operators as good working conditions as possible, the crane cabs are placed on the end of the crane nearest the outside walls and farthest from the heat producing areas. Consideration was given to air conditioning equipment for the cabs but the operating company felt that because air conditioning equipment is on the critical materials list they would try to operate without conditioned cabs and, if necessary, make the installation later.

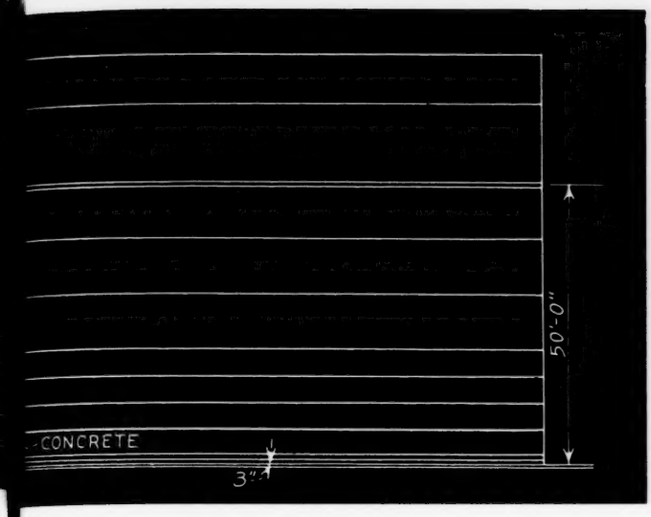
Offices and toilet rooms are ventilated with disc type fans provided with automatic back draft dampers similar to *kitchen fans*.

The production and maintenance buildings are heated by means of gas-fired unit heaters located in the working areas only, acting as spot heaters. Areas used for storage, furnaces, cooling pits, and so forth, are not heated. In fact, during the greater part of the operating year, the building will be heated by the production equipment and by the cooling of the castings.

The production building offices are heated with gravity type, cased, gas-fired room heaters vented to the atmosphere.

The non-productive buildings were treated in a very different manner because of their different function. Here there are two general types of buildings, those which are primarily office structures, and those which are primarily factory or storage space. The latter are very simply ventilated with gravity type ventilators provided with a propeller type fan in the throat to give positive ventilation when weather conditions require it. The working space is heated with gas-fired unit heaters and the office space with gas-fired room heaters the same as the production buildings.

The Administration Building is arranged for air conditioning although, for the present, the refrigeration condensing unit and the water cooler will not be installed because this material is on the critical list. The system is arranged so that some cooling can be obtained by running well water through the coils. This building, which is two stories in height, is zoned into six sections, each with its own conditioning unit. This was done to keep the system flexible and to keep the duct sizes small. The air is discharged into the rooms through standard grilles. The return air is exhausted from the rooms into the corridor which is used as a return air duct, through louvers in the bottom section of the doors, and is carried back to the conditioner equipment room. The conditioners are arranged so as to allow the fresh air—recirculated air ratio to be varied over the entire range. Heat for the units is supplied by a low pressure gas-fired steam boiler arranged for automatic operation, and located in a small boiler house adjacent to the Ad-



Partial side elevation of Foundry showing outside air louvers along the sides and continuous roof ventilators.

ministration Building. The steam supply and return piping is run just below the first floor joist. The return to the boiler is pumped to give a positive flow.

The Laboratory, Personnel Building and the Fire and Police Station are supplied with steam for heating from a small boiler house located adjacent to the Personnel Building where it also supplies steam to the kitchen and cafeteria. These buildings are heated with low pressure cast-iron direct radiation. An interesting problem was encountered here in that the buildings set at grade level with no space below the building for the return piping. In fact, the floor in some cases is concrete. Because of the function of the buildings and the critical material involved, the use of unit heaters, which would have permitted the piping to be kept overhead, was not suitable. Pipe trenches in the floor were ruled out because of the refuge they provide for all kinds of insects and vermin which thrive in this part of the country. It was finally decided to carry the supply overhead in the usual manner for buildings set as low as these, and to run the return in the ground outside of the building. The pipe, of course, is properly covered and protected. This eliminated all interference with doorways, walkways, etc., and at the same time allowed the return to be carried at satisfactory grades back to the boiler house where it is picked up by a pump and returned to the boiler.

The ventilation of these buildings was somewhat different from the balance of the buildings on the project. In general, all toilet and locker rooms are ventilated by the use of small individual propeller type fans with automatic back-draft louvers, the same as the production buildings. These units are inexpensive and where the rooms to be ventilated are separated, as they are in these buildings, the use of these fans saved both material and cost. No provision was made for the ventilation of the offices in these buildings except by the use of windows.

The laboratories in the Laboratory Building are ventilated not only through the chemical bench hoods which take off the fumes and vapors produced by the chemical tests being made, but are also ventilated by means of grilles opening into the attic space which is exhausted to the out-of-doors by power driven propeller type fans. In addition to this, the Macrographic Laboratory has a special ventilating system handling the acid fumes from its etching pots. This system is largely of Duriron and consists of a hood over the pots and exhaust fan with ductwork.

The Personnel Building houses besides the employment, first aid, and personnel offices, the locker, shower and toilet rooms, cafeteria and kitchen necessary to take care of the three groups of employees working at this plant, i.e., the office workers, the white factory workers and the colored factory workers. In addition to the above, this building has a six-room hospital section to care for the sick or injured until they can be removed to their homes or to the hospital in town. These rooms are equipped with unit air conditioners operating from a central condensing unit. These rooms are vented by their own exhaust system of ductwork and fan to the out-of-doors. Keeping the rooms under a slight vacuum eliminates the possibility of hospital odors permeating the building.

From the gate house at the entrance of the plant to the main production and administrative buildings, every effort has been made to make the plant an efficient and well organized unit capable of producing large numbers of gun barrels in an economical manner, with personnel working under conditions as convenient and comfortable as possible, and still conserving critical materials and valuable time.

The plant and facilities were designed by Shreve, Anderson and Walker, engineers and architects of Detroit, Michigan. The field engineering and the supervision were also handled by the engineers and architects under the general direction of the United States Army Corps of Engineers.

ARMOR PLATE

FORD MOTOR COMPANY ROUGE PLANT

By RAY W. TUER
Chief Mechanical Engineer, Shreve, Anderson and Walker, Detroit

AT the inception of the Defense Program in this country, the Ford Motor Company was given contracts for producing numerous materials and implements of war. One of these materials was armor plate for the M-4 tanks. In characteristic Ford procedure, studies were made of the accepted processes of producing this material, and new methods were developed which would produce more and better armor plate. Among other things, Ford developed a new method of quenching the plate in the heat treating process that eliminates warpage and its resultant straightening operations.

The plant for producing this plate, designated by Ford as the Armor Plate Building, is located in the Rouge Plant at Dearborn, Michigan. The building and facilities were designed by Shreve, Anderson and Walker, Engineers and Architects of Detroit, in collaboration with the engineers of the Ford Motor Company.

The Armor Plate Building is approximately 1100 ft long by 235 ft wide arranged with two wide single story bays having a height of 35 ft to the under side of the truss, for manufacturing, and a 32 ft two-story bay for offices, tool cribs, toilet rooms, first-aid room, control rooms, mechanical rooms, and so forth.

Description of Processes

The equipment in this building is designed to process steel plate in sheets up to 4 ft in width and 16 ft in length. The material is handled by overhead cranes and by live roll and chain transfer conveyors. All equipment is of the latest design and arranged so that the flow of material is progressive. The material is received at one end of the building, where it is sorted and stored ahead of production. From this storage, it is cleaned by shot-blasting, inspected and fed into the heat-treating furnaces. The high temperature heat-treating furnaces are of the controlled atmosphere tunnel type, 200 ft long, heated by radiant tube heaters. The quenching is done in large 2500 ton quenching presses, each using approximately 2000 gallons of water per minute. The use of these large quenching presses eliminates the warpage which generally takes place in the usual quenching operation. The low temperature or draw furnaces are of the direct-fired tunnel type and are about 300 ft long. The equipment is arranged so that any plate can be quickly transferred from any high temperature furnace into any press and then into any low temperature furnace as required, by a system of transfer conveyors with hydraulic lifts. After heat treating, the plates are again inspected, tested, cleaned by shot-blasting and processed through a leveler. The work is then laid out on these plates and the required cutting, welding, bending, and shearing is done.

The cutting and welding is done by automatic equipment which only requires that the flame be manually adjusted and that the templates be properly placed. From these operations, the parts, after inspection, are shipped to the assembly lines.

Facilities and Conveniences

The building is of steel frame construction with brick breast wall, steel sash, gunite bands between and above the sash, concrete roof tile, and concrete and brick floor.

Considerable attention is always given in Ford Motor Company plants to providing visitors with a convenient and interesting view of the operations involved in the manufacturing processes. In this building, a visitors' walkway was included in the design of the building but because of the need to conserve critical materials this walkway will not be built until after the war. As planned, this walkway will extend the entire length of

BUILDING

the building at an elevation which will permit the visitors to view the operations over the entire factory floor. The laboratories, with the exception of the darkrooms, are provided with large display type windows between the aisleway and the laboratory. Laboratory equipment is also arranged so that the visitors can readily see this phase of work.

Large locker and lunch rooms have been provided for the employees in addition to the toilet room facilities which, in this case, include showers.

A fully equipped first-aid room, supervised by a competent doctor, has been provided to take care of minor injuries which may occur. In the Rouge Plant these first-aid rooms are supplemented by a plant hospital capable of handling major injuries.

Large amounts of electrical power, gas, and water are used in the processes. All utilities to this building are looped in such a way that the building can be fed from either or both of two sources from the existing plant facilities. With the exception of one gas line, all of these services are brought into the building underground not only for the safety this provides, but also for the improvement in appearance.

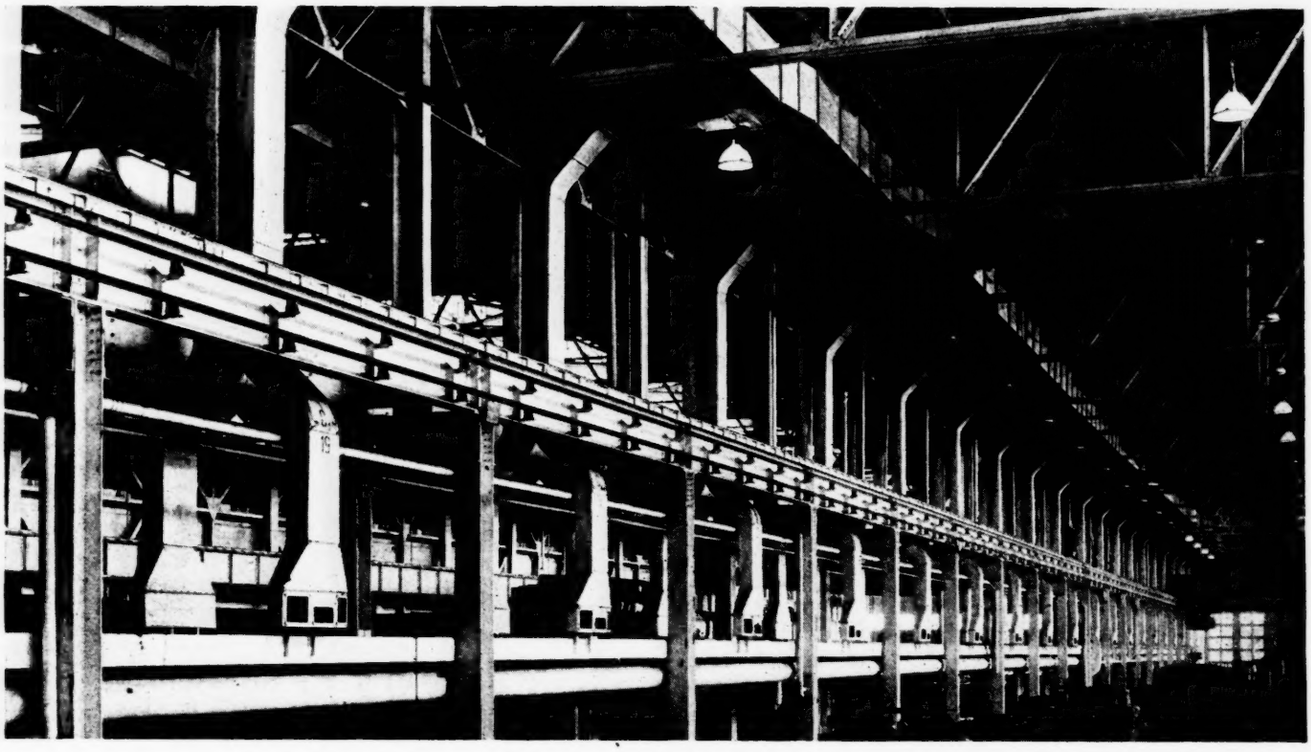
Heating and Ventilating

The method of heating and ventilating this building was determined by the following four factors:

1. The desire of the Ford Motor Company to provide its employees with controlled quantities of fresh air.
2. The large size of the intervening processing equipment.
3. The large floor areas involved and the need of getting good distribution of air over the entire floor area.
4. The fumes and the smoky condition caused by the furnaces and the cutting and welding operations.

Offices

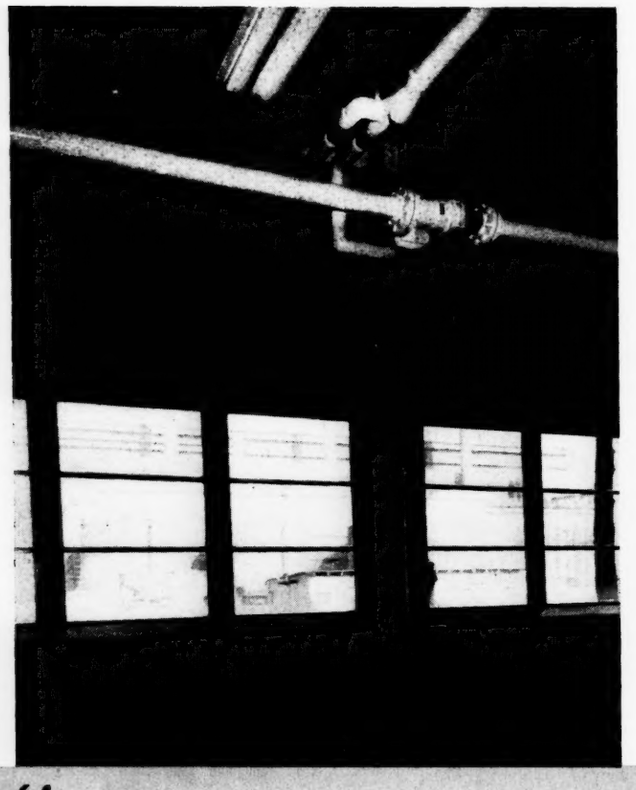
The offices are heated by a split system, consisting of Vulcan type steel fin radiation with covering



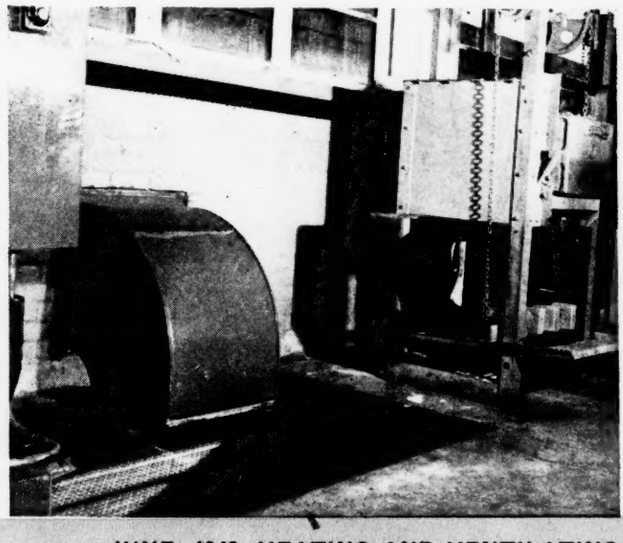
View of the upper part of the armor plate plant, showing the ductwork which distributes heat and fresh air throughout the building. A trunk duct from one of the eight circulating units, together with laterals, drops, and grilled outlets, is shown.

grilles, and a heated fresh air supply. The Vulcan radiation was used in the design because of its compactness and the fact that it would leave the wall space at desk level clear. The fresh air supply to the office space not only keeps the air fresh but by keeping a slight pressure on the offices, the dirt and dust that ordinarily would sift into the offices will be largely eliminated. This fresh air supply is taken from above the roof level, is filtered, heated, and distributed to the first-aid room and offices. The filters used in this installation are American Air Filter Company Kompak renewable type units. This type unit has become a standard at the Rouge Plant because with the numerous installations which they have it is a decided advantage to have standardized

Grille covered fin-type radiation, controlled by the disc-shaped thermostat and self-contained steam valves overhead, offsets window heat loss in the engineering offices.



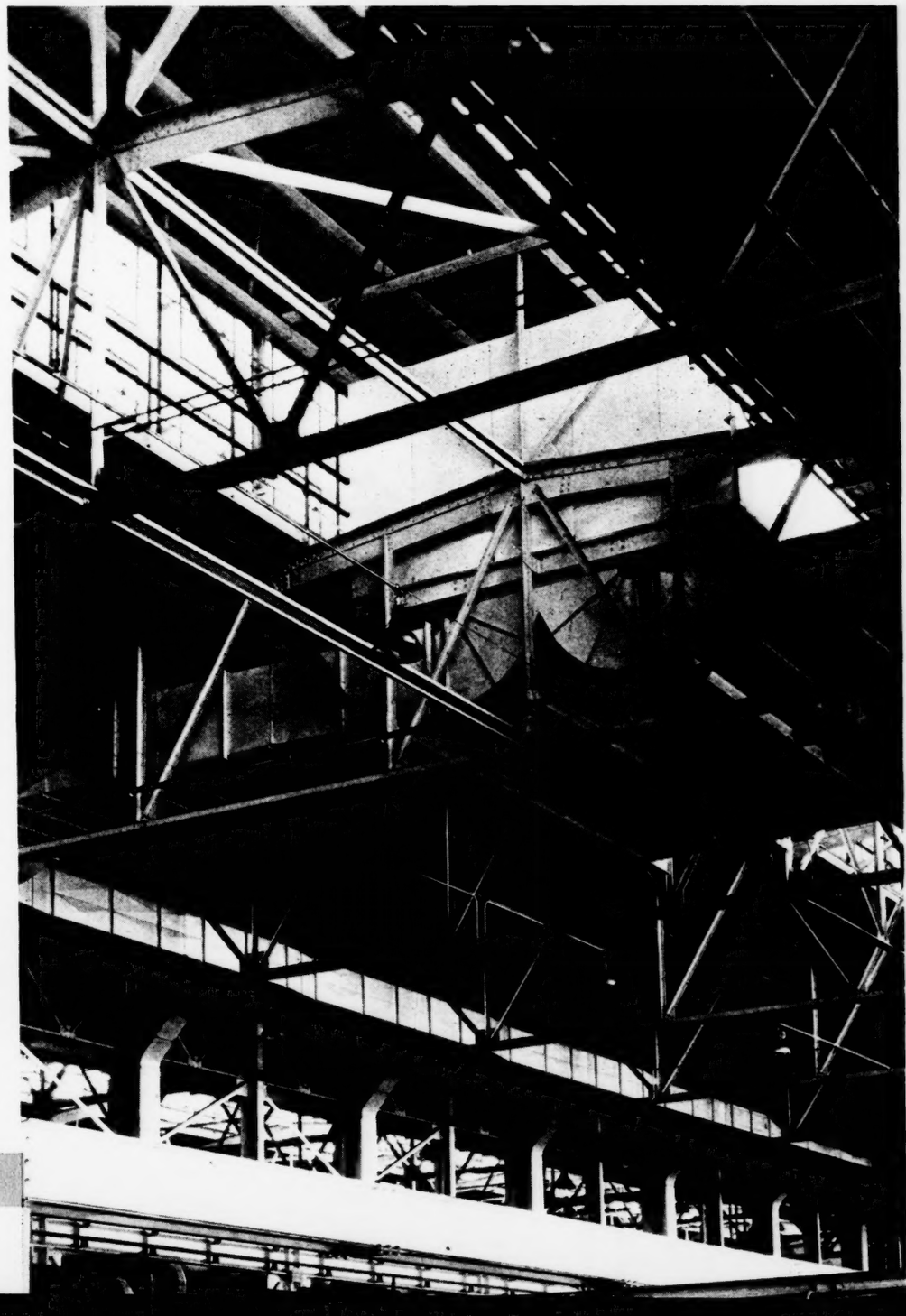
Fumes from small heat-treating furnaces in the laboratory are exhausted through this elbow by a fan and duct system under the floor. A large canopy (yet to be constructed over the furnaces at right) will funnel the gases down into the duct through a hole in the floor.



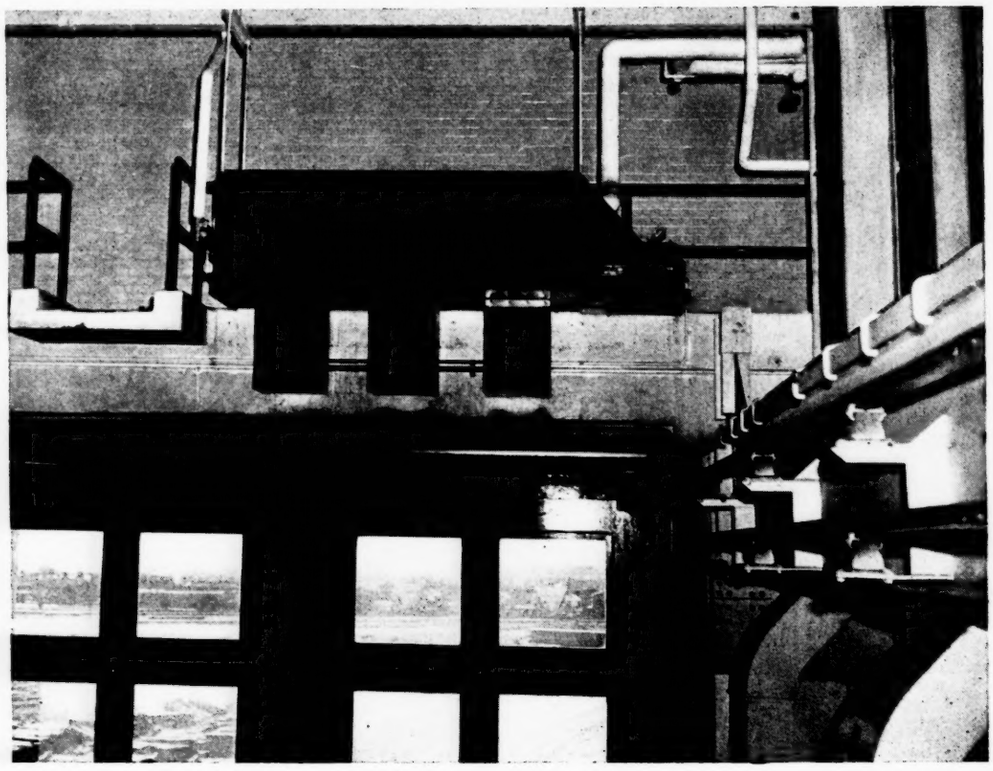
equipment. The coils are of Trane Company manufacture and comply with the Ford standard non-freeze extra heavy tube specifications requiring that the coil be designed for operation at 200 psi and 550F and having a wall thickness of not less than 0.049 inches. A Clarage fan from the Ford stock was used, since it was impossible to obtain delivery on fans of the required size and specification in time to meet operating needs. Powers controls were used. This equipment is all located on the second floor of the office section in the mechanical equipment room.

Factory Ventilation and Heat

Of major consideration in the design of the heating and ventilating system for the manufacturing section was the need to supply the men in this area with heated fresh air in the winter, and cool fresh air in the summer. This section is heated by a hot blast system arranged to take the fresh air supply from above the roof level. This air is filtered, heated, and distributed to the working area at a height of about 10 ft above the floor. To save floor space, the equipment for this system is installed in eight fan rooms located in the monitors. Each fan room handles 80,000 cfm and is arranged for recirculation of air. Each room occupies only one 25 ft bay of the monitor space which gives an indication of the compactness of the design. Staynew automatic self-cleaning oil type and air filters clean the air. Trane non-freeze coils, complying with the Ford standard,



One of the eight overhead heating and ventilating equipment housings and typical ductwork. Each such unit handles 80,000 cfm.

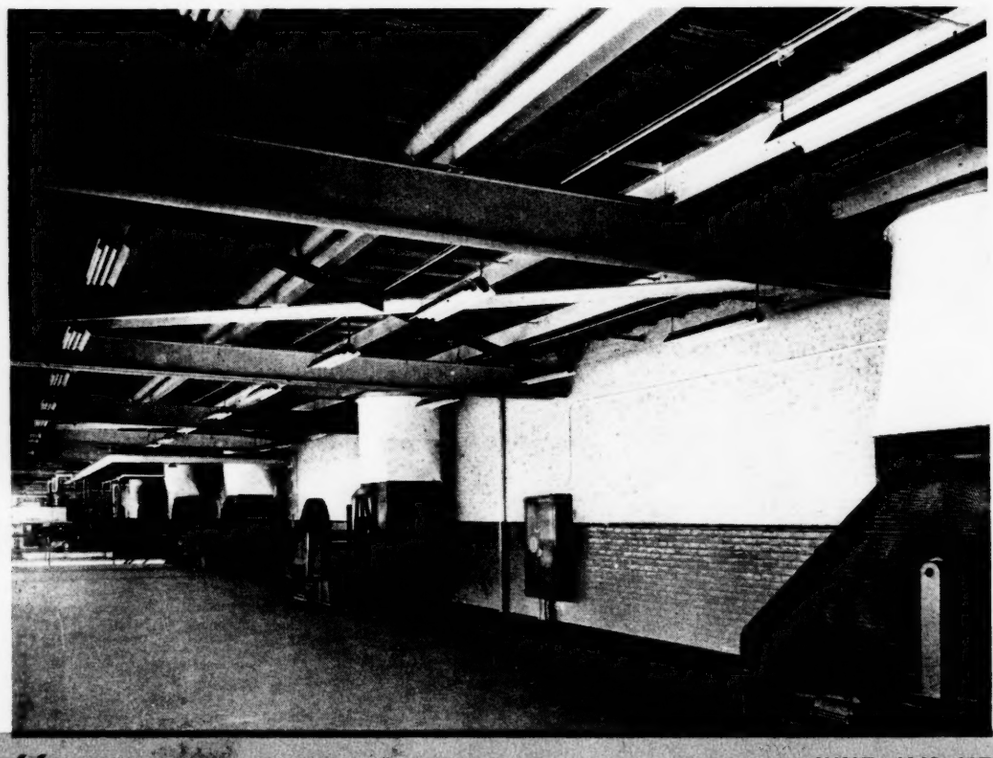


Large overhead unit heaters pour heat down and seal the openings against inrush of cold air when the doors open to admit railroad cars. The photograph was taken from an overhead crane.

heat it to the proper delivery temperature as determined by a Powers duct thermostat operating the face and by-pass dampers on the coil. The Clarage fans are double width double inlet units. Considerable discussion was given the matter of having the controls close both the face and by-pass dampers when the fan is not operating, but company engineers decided that this feature and an automatic control valve on the steam supply to the coils, although desirable, was not necessary at this time because such valves and controls are very hard to obtain. An automatic control valve will be installed when this condition changes. For the present the maintenance men caring for the heating stations manually operate the steam supply valve.

Control of Distribution

In the factory air supply system, control is maintained by splitter dampers in each drop and by control dampers behind each grille. There is one drop in each bay on each column row and the drop terminates in three distribution grilles so arranged that



The mezzanine section above the engineering offices contains the blower units which expel fumes from the heat treating furnaces out through the roof.

two of the grilles may be closed, reducing the air volume approximately one-half and still giving a satisfactory air distribution.

Individual heaters are provided over the large truck and railroad doors. These heaters are provided with discharge nozzles directing the air downward past the doorway to act as an air screen. These heaters operate continuously.

The heating system has had a real test this first season of operation in that the outside temperature has been below zero many times.

The smoke and foul air is exhausted from the factory section of the building by means of power driven roof ventilators of black-out design manufactured by the Allen Corporation. These units are located in the roof of the monitor and are equally spaced the length of the building. The units are fairly low and hardly discernible from the ground. The toilet rooms, lunch rooms, and so forth are ventilated by the use of similar power driven roof ventilators.

Miscellaneous Ventilation

In addition to the general ventilation there is considerable ventilating necessary in connection with the equipment used in processing. As an example:

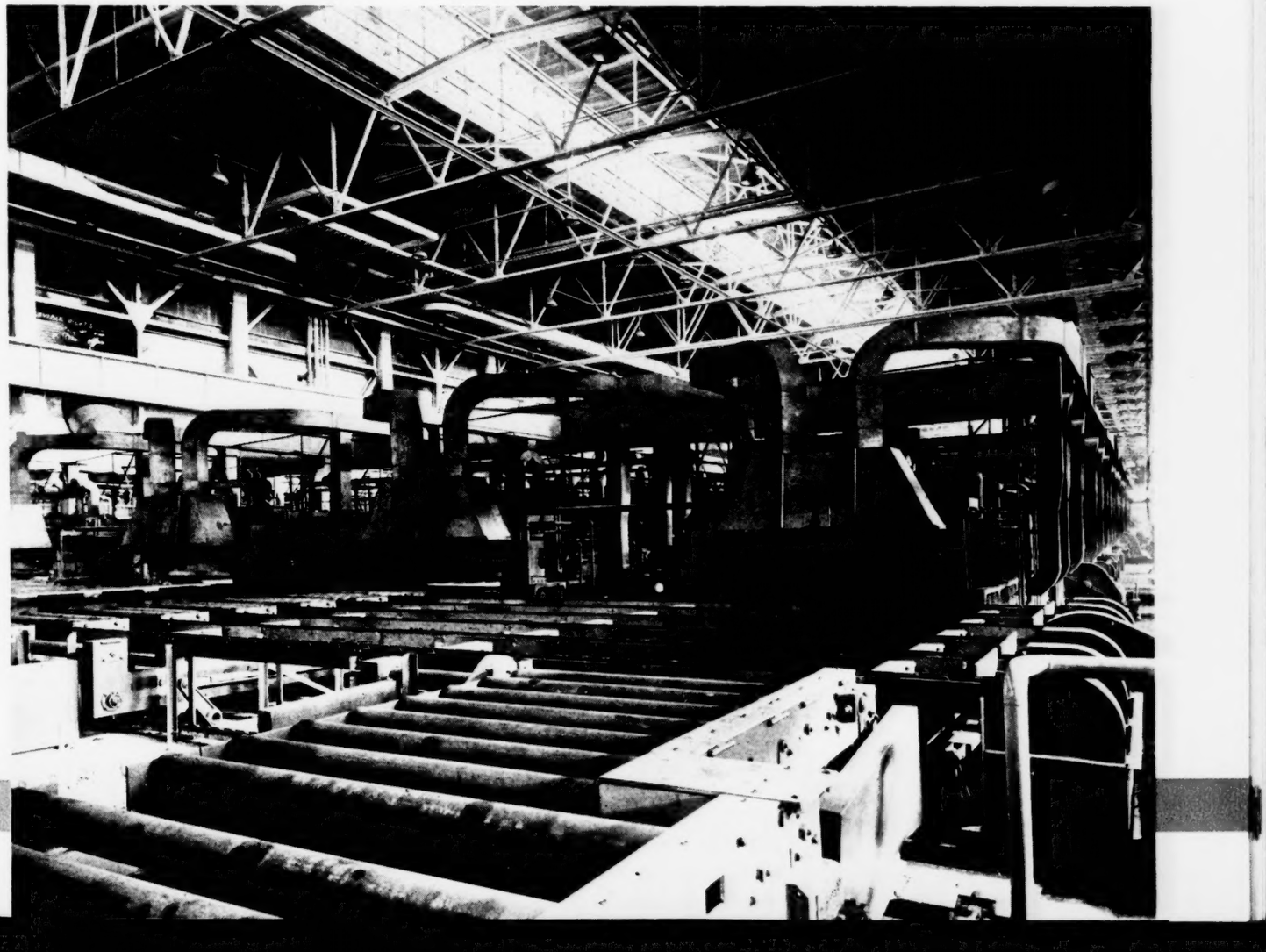
There are three shot-blast installations in the building, each one of which is completely housed in. These houses are exhausted to the outdoors by means of power driven exhaust fans. The dust from this operation is removed from the exhausted air by bag-type dust arrestors. The hoppers of the dust arrestors are set high enough above the floor so that factory type trucks can be backed under the hoppers for removing the accumulated dust and dirt.

The high temperature heat treating furnaces are tunnel type units approximately 200 ft long and are arranged with controlled atmosphere equipment. These furnaces are heated by radiant tube heaters. Hoods have been installed over the doors and the exhaust ends of the radiant tubes for drawing off the fumes and gases of combustion. Five fans, each with a capacity of 44,000 cfm, exhaust from these hoods and discharge the gases above and away from the fresh air intakes to the building.

The electrical sub-stations are provided with sufficient ventilation to maintain the transformers and switch gear at a safe operating temperature. This is done with two small fans taking air from the factory space, filtering it, then discharging this air into maintenance costs of the sub-stations.

The heating work was installed by the Donald Miller Company of Detroit, and the ventilating work by I. Brodie and Son, Inc The general contract was handled by J. Utley and Company.

Waste combustion products from the large plate heat treating furnaces are carried away through this elaborate system of exhaust ductwork.

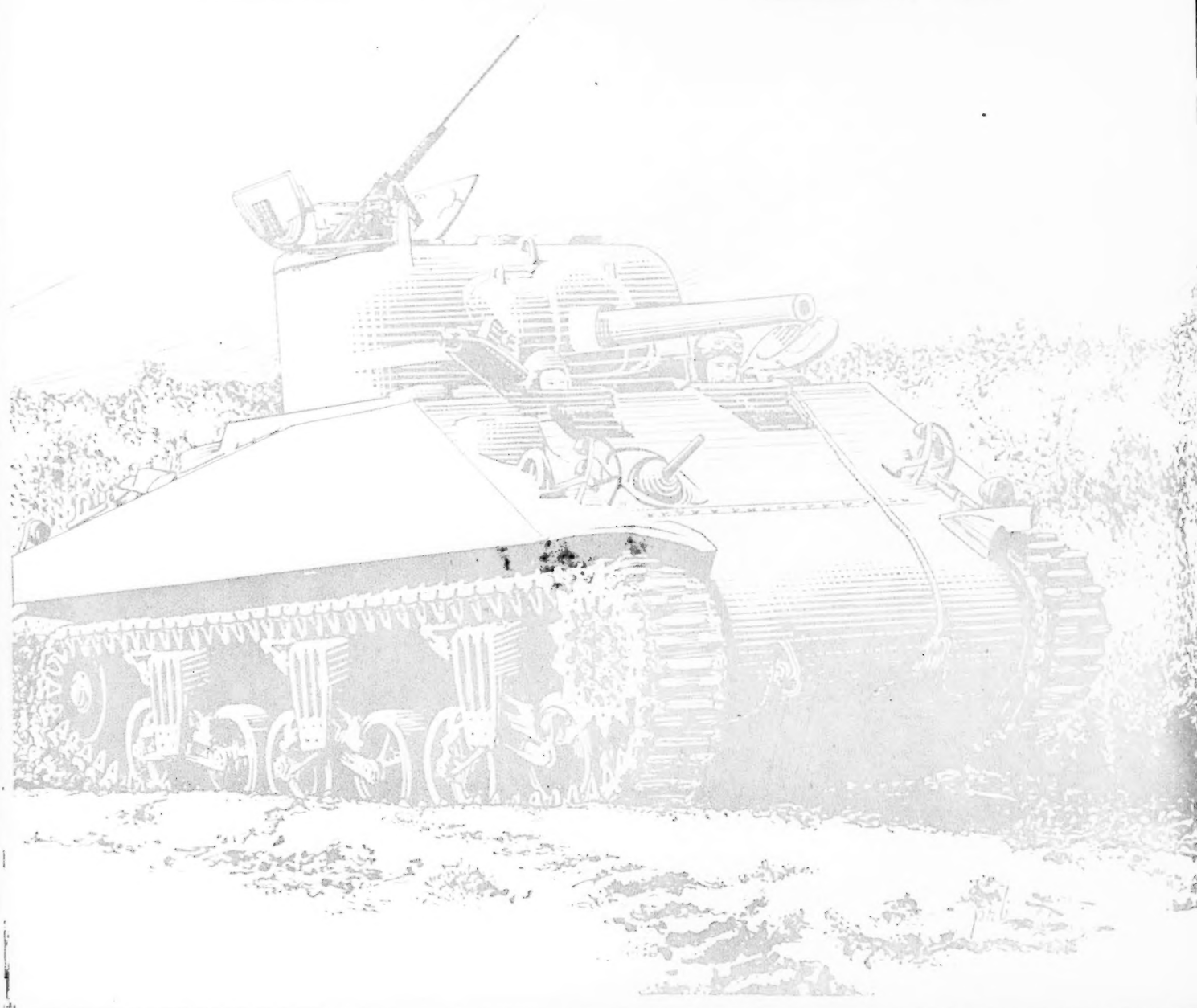


CARNEGIE-ILLINOIS

High pressure steam heats extra-heavy armor

By ROBERT E. HATTIS
Consulting Engineer, Chicago

Mr. Hattis has been an independent consulting engineer in Chicago since 1926, and has handled over fifty million dollars of commercial, industrial and institutional buildings. After graduating from the University of Illinois with highest honors, he was associated with such concerns as A T & T, the Panama Canal, Byllesby Engineering and Management Company. He is a past President of the Illinois chapter, ASHVE; has served on Western Society of Engineers committees; and is secretary of the Chicago chapter of Tau Beta Pi. Included among his projects are buildings for Northwestern University; Battle Creek Sanitarium, University of Notre Dame; Carson Pirie Scott Men's Store; numerous schools; Bahai Temple; and industrial buildings for National Aluminate; Carnegie-Illinois, Florsheim Shoe; and many others.



Mechanical Engineering on This Project by

ARMOR PLATE PLANT

plant of Carnegie-Illinois Steel Corp. near Gary

THE most interesting story about a war plant would relate to its marvels of production of war machines now dealing such blows to the enemy that we may look forward to a reasonably early end to this war, but it can not be told until after the war is over. As this particular war plant, located near the Gary Works of the Carnegie-Illinois Steel Corporation, is engaged in converting steel slabs into finished and partly finished armor plate, it is essentially a steel plant and like most steel plants its ventilating story is simple and involves means—mostly by openings in walls and by continuous roof vents—for the release by gravity of the tremendous quantities of heat from red-hot metal to make the plant liveable in summer.

In fact, the heat from hot metal and the various metal heating and heat-treating furnaces takes care of the winter heating of many portions of the plant, but there is still a considerable heating problem in the balance of the plant, the description of which should be of interest.

Building Construction

This plant is built on an irregular plot of ground about one mile long and one quarter of a mile wide. The major portion of the plot is covered with solidly connected steel mill buildings in which the metal processing is done. All around the main buildings are about sixty auxiliary buildings, mostly of wood construction, housing boilers, air-compressors, offices, storage spaces, restaurants, wash-houses, fire-station, hospital, and so forth.

The mill buildings are windowless, while the auxiliary buildings have windows. Only about half of the mill buildings are heated and these have dampers in the gravity vent openings. Practically all of the auxiliary buildings are heated. The mill buildings have concrete floors on the ground, steel columns, steel roof-trusses forming gable roofs with spans close to 100 ft and clearance under the trusses ranging from 25 to 45 ft, and have corrugated transite wall and roof enclosures.

Some of the auxiliary buildings have concrete block and brick walls, but most of them have wood stud walls with wood sheathing and asbestos siding outside, with wood roof trusses forming gable roofs also wood sheathed and covered with asbestos shingles. All wood constructed auxiliary buildings which are heated have insulating board generally applied to provide an air-space and forming the interior finished wall and ceiling surfaces.

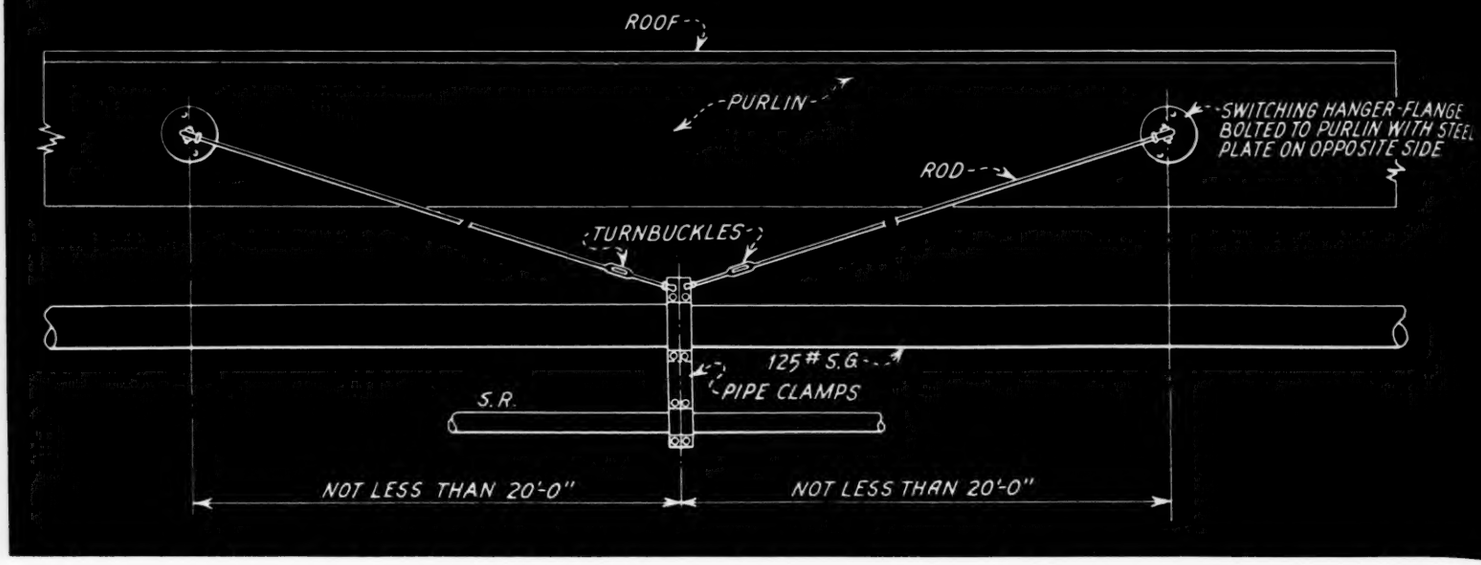
Description of Boiler House

Near the load center of the plant is located a boiler house containing four boilers fired by combination natural gas and bunker coil burners at 200% of rating to develop a total of approximately 5000 hp, somewhat under half of which is required for building heating. Gas is the main fuel and oil is the standby fuel. The boilers operate at about 160 lb per sq in., at which pressure saturated steam is provided for use in large steam hydraulic presses substituted for certain electrical hydraulic presses to make possible the completion of the plant on schedule. As much of the equipment for all other process steam, for heating domestic hot water and for building heating was already purchased for the original steam pressure of 125 lb per sq in., reducing valves were provided in the boiler house to provide this pressure.

Combustion controls provide proper fuel-air ratio for maximum efficiency to maintain constant boiler pressure with varying load. Steam flow meters measure the performance of each boiler.

Only a portion of the condensate is returned, involving about 75% raw-

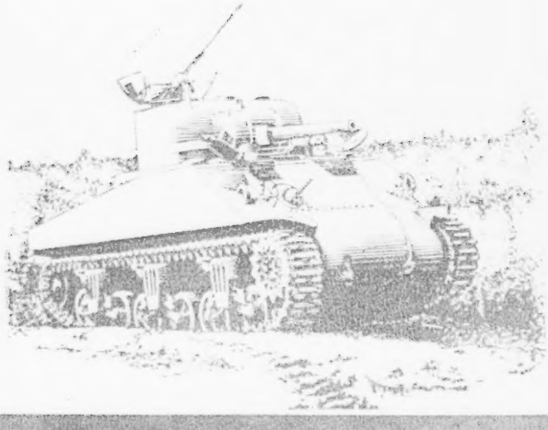
ROBERT E. HATTIS, Consulting Engineer, Chicago, Illinois

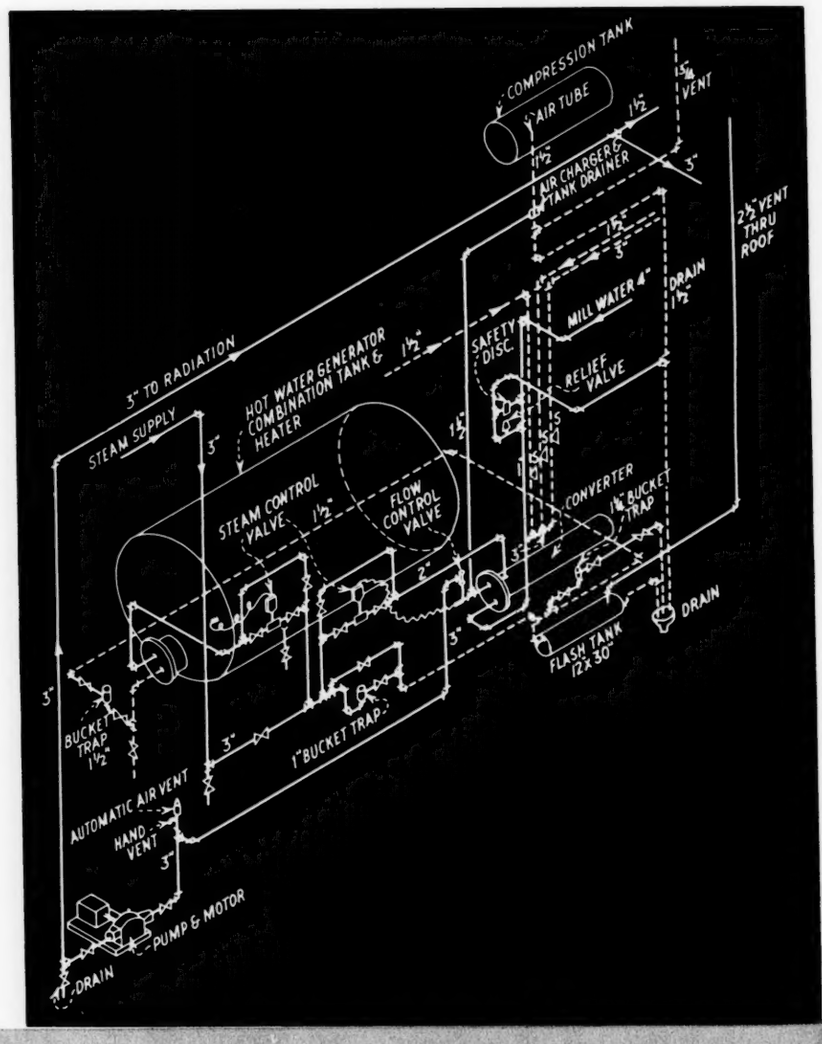


Detail of turnbuckle type of anchor for steam supply and return piping. Two steam mains from the boilers serve the plant, one at 160 lb pressure supplying presses, and the other at 125 lb handling all other heating and processing requirements.

water makeup at peak load. Internal water treatment and continuous blow-down keeps boiler water clean and boilers scale-free. Exhaust steam from boiler auxiliaries heat the makeup water in an open feed-water heater to about 200F. Turbine driven pumps controlled by boiler water-level regulators supply the boilers with feed water.

Schematic diagram of typical domestic water heating equipment and piping connections. Steam-storage heaters using 125 lb steam have self-contained control valves to maintain fixed tank water temperatures.





Two steam mains leave the boiler house to serve the plant. One at 160 lb per sq in serves the large hydraulic presses referred to above. The other at 125 lb serves all other process steam requirements, building heating and domestic hot water heating. Most process steam is used for atomizing oil in steel heating furnaces at full pressure. Certain other process steam serves kitchen equipment requiring 25 lb steam obtained by reducing valves. Domestic hot water is heated in each space requiring same by means of steam-storage water heaters using 125 lb steam through self-contained steam control valves to maintain fixed tank water temperatures. The heating systems will be described below.

In general, steam and return mains are schedule 40 black steel pipe, carried on brackets attached to building columns and run on the outside of buildings. Interior piping also follows the columns on brackets, but rises to run in the trusses where necessary to clear cranes and other equipment. Provision for expansion is provided by means of rectangular U-bends made up with weld-ells. Most of the piping was fabricated with welding fittings. A minimum of valves was provided, only enough for proper maintenance and to shut-off heating lines in summer.

All steam piping and condensate return piping is insulated, and that which is run outdoors also has a weather protective coating. Drips at low points are trapped and wasted to sewers.

Kinds of Heating Systems

Several types of heating systems are used in this plant, as follows:

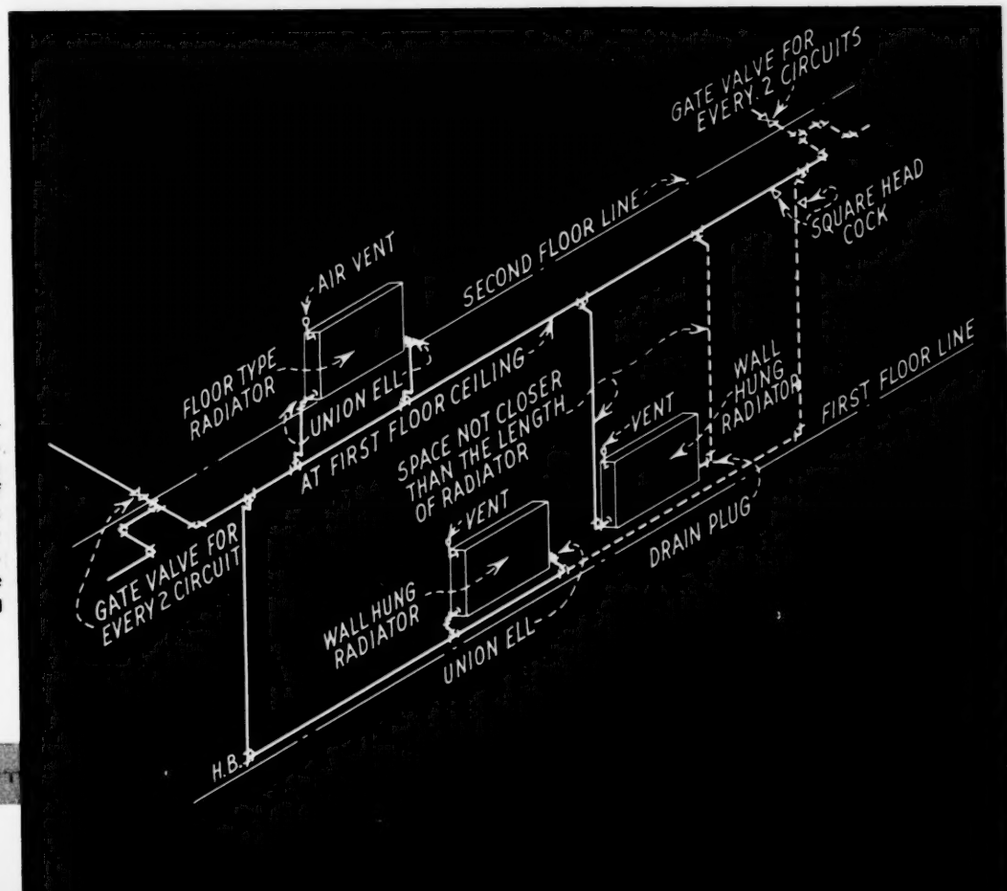
Unit Heaters. Vertical down-blow projection heaters serve the large mill building spaces. These are mounted in the roof-trusses from 25 to 45 ft above the floor, to clear cranes. The units generally each range from 400,000 to over 2,000,000 Btu per hour capacity and form by far the major portion of the building heating load. They are supplied with steam at 125 lb, but the outlet temperatures are kept low by wide spacing of tubes and fins. They are controlled in groups of one to four by electric room thermostats located on columns in the heating zone, and these thermostats through relays start and stop the unit heater fans. Constant steam pressure is kept on the heating coils and individual shut-off valves permit additional manual control and maintenance.

In general, the condensate from all of these unit heaters is returned without the aid of pumps to the open feed-water heater in the boiler room.

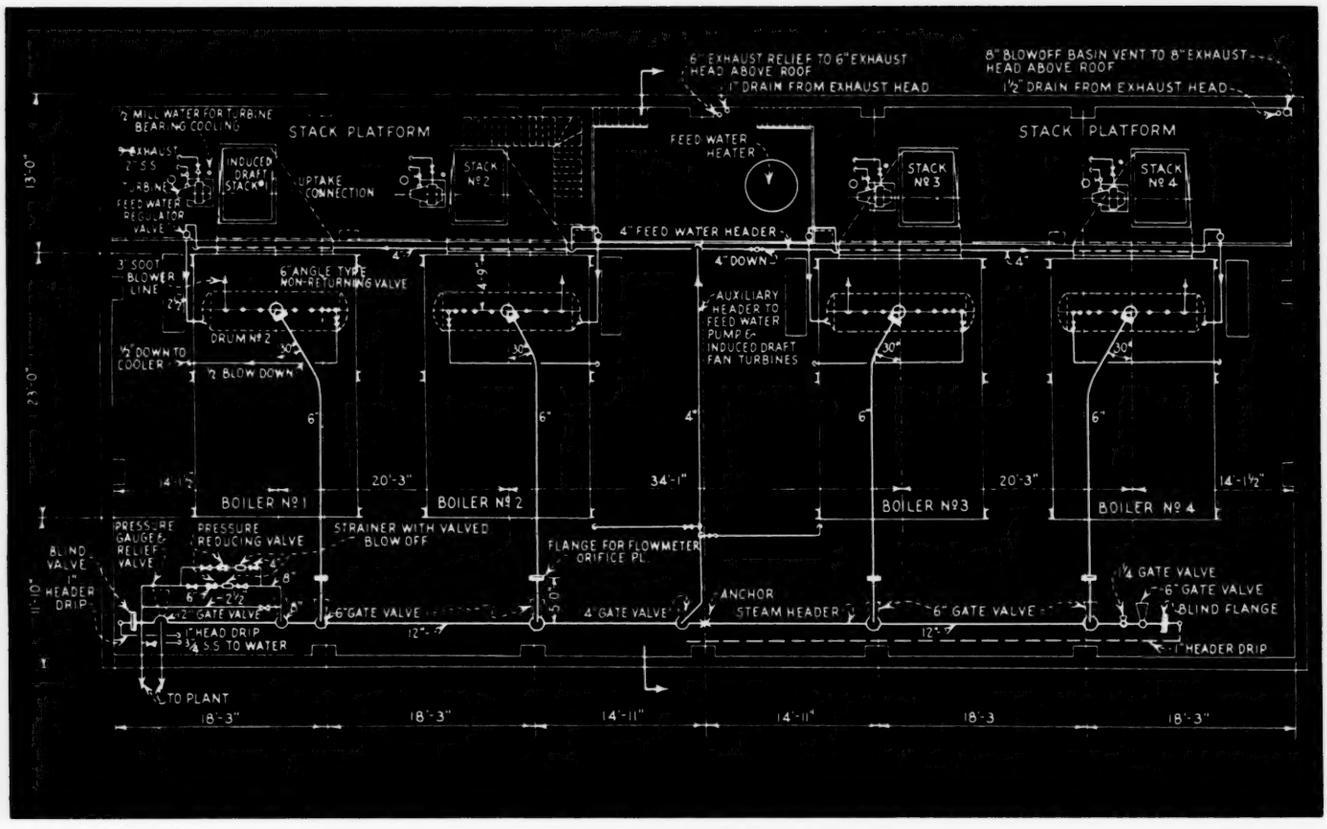
As there is considerable process heat and heat from the lighting day and night in these windowless mill buildings, all of which would go to the roof spaces and out through the ventilators, the vertical projection heaters make possible the use of this heat by blowing it down to the floor where it can be of benefit to the workers. Additional benefits come from saving in floor space, shorter branch piping connections from the heating and return mains, and so forth.

Steel Convectors and Pipe Coils. These are used in small mill toilets located in unheated mill buildings and other small spaces not requiring close temperature regulation. They are served with steam at 125 lb, have manual control valves, and waste the condensate through vented flash tanks into storm sewers. These are few in number and form a very small percentage of the total heating load.

Cast-iron Radiators with Circulated Hot Water



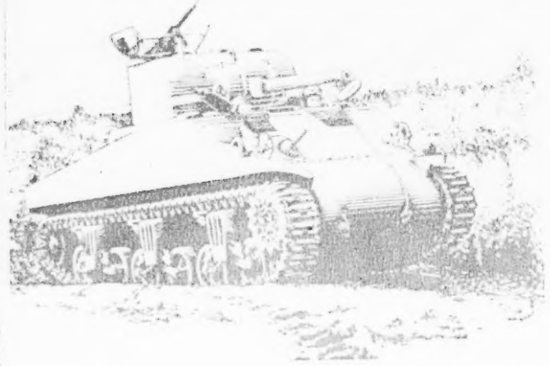
Sketch showing typical radiator connections for circulating hot water heating systems used in most of the auxiliary buildings which number close to sixty. This radiation represents about 20% of the total mill building heating load.



Plan of upper part of boiler house showing arrangement of high pressure steam boilers and piping, turbine-driven induced draft fans, reducing valves, and other equipment.

Heat. This is used in most of the auxiliary buildings. There are close to sixty buildings, some of them quite large, and this load is about 20% of the mill building heating load. The spaces are important and require good temperature control.

Cast-iron radiation was mandatory instead of unit heaters wherever it could be used. To avoid critical steam reducing valves, to avoid buried return piping, to have radiation at the floors with mains at the ceilings, to have inexpensive yet effective temperature control, a forced circulation hot-water system was decided upon for each building. Control is by room thermostat starting and stopping the pump. Steam at 125 lb heats the water through converters controlled by self-contained steam control valves to maintain fixed flow-water temperatures. Condensate is wasted to sewers through vented flash tanks. Small expansion tanks with relief valves provide for expansion.



In general, flow mains are run at the ceilings and feed drops to several one-pipe runs through shunt fittings. These runs each serve six or seven radiators between door openings and then rise to meet return mains at the ceiling to complete the circuits. Manual vents provide for release of air on trapped radiators. Systems generally have an automatic vent at one or two high points to vent all piping. Radiators generally have union-elbows, no shut-off valves. Cocks in return mains facilitate balancing. Gate valves ahead of one-pipe mains provide shut-offs for repairs. Cocks at low points, generally with hose connections, provide means for emergency drainage. The pipes and pumps are small, the accessories few. Steam sized radiators are used. The systems furnish very comfortable heating and are economical.

Cast-iron Radiators Using Low-pressure Steam. This is used in the Administration Building, the Gate House and the Employment Office—all located near the plant entrance. These buildings were completed at the very start of the project and are served with steam by a small cast-iron hand-fired coal boiler located in the Administration Building. The buildings were used by the architects, engineers, contractors, army officers, government staff, operating staff before the main boiler plant was even planned.

The heating system is two-pipe gravity steam with a manual valve and thermostatic trap on each radiator, with a condensation pump for each building returning condensate back to the boiler.

An electric outdoor compensating thermostat intermittently operates a motorized steam valve in the steam main serving these buildings to maintain comfortable interior temperatures. A damper in the ash-pit of the boiler is controlled by boiler pressure to modulate air supply to boiler to attempt to maintain not over five lb pressure. As the boiler is hand fired the boiler pressure may rise when the control shuts off the main steam valve before the draft control can take hold. To avoid popping of the safety valves which are set at 15 lb, a relief valve releases excess steam at 10 lb into the heating main causing a temporary over-heating until the draft controls take over.

The central heat control has accessories in the boiler room for adjusting interior temperature, for putting the heat on full and for shutting it off. This system totals 10,000 sq ft of steam radiation.

With the completion of the main boiler plant, the hand-fired boilers were no longer fired, as steam from the 125 lb lines through reducing valves serve instead. The condensate is now being wasted to the sewer. After the war emergency, should the plant be shut down, the minimum plant staff can be served from the hand-fired coal boiler with a minimum of expense.

Electric Heaters. These are used in a very few locations which are remote from steam sources or are difficult to serve by overhead pipes due to crane obstructions. Seven watch towers and about six operators' pulpits were each equipped with four kw electric heaters with full—half—no heat manual control.

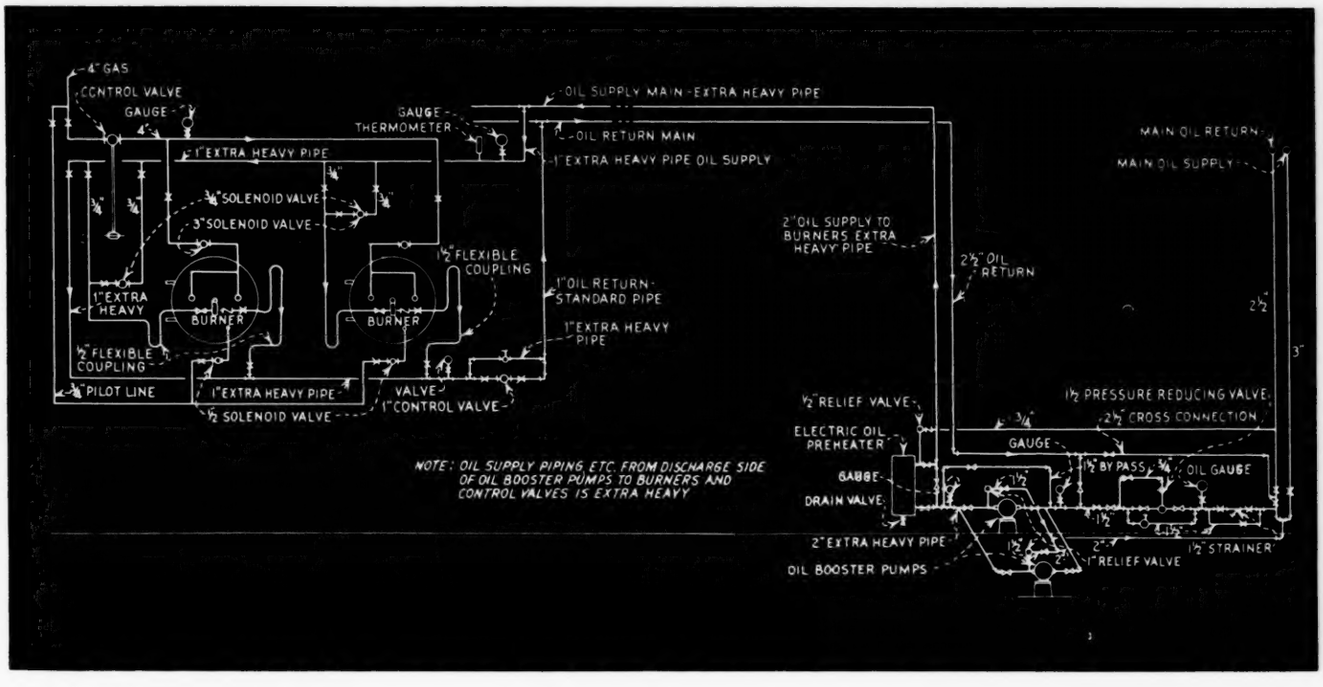
Conclusion

Before closing this article, I want to express the feeling of pride held by all parties involved in this project. Budgeted at $35,000,000, it was built for far less, was finished on schedule, and is operating to the complete satisfaction of the Army and the Carnegie-Illinois Steel Corporation. The engineering staff of Carnegie-Illinois Steel Corporation, Gary Works, designed the production equipment. My part in the project was as chief electrical and mechanical engineer for Alschuler and Friedman, the architectural engineers retained by the Corp of Engineers. The constructors for the Corps of Engineers were Marsh, Peterson, Walker & Snyder, under whom all work of all trades was done. The heating plant, along with all other piping work, was done by Gordon, Wheeler & Blaney, headed by Mr. William V. Heier, who did an excellent job.

Partial List of Equipment Suppliers

Cast Iron Radiators..... American Radiator Co.
Hot Water Heating Accessories ... Bell & Gossett Co.
Reducing Valves..... Boylston Steam Specialty Co.
Steel Boilers..... Bros Boiler & Mfg. Co.
Steam Heating Specialties. Illinois Engineering Co.
Insulation.....Johns-Manville Corp.
Unit Heaters..... Modine Mfg. Co.
Convectors..... The Trane Co.
Cast Iron Heating Boiler.. Weil-McClain Co.

Schematic diagram of boiler fronts, showing oil and gas manifolds and oil preheating and pumping equipment. Gas is the main fuel and bunker C oil is used for standby purposes.



PICATINNY

USES AIR CONDITIONING TO IMPROVE

By H. W. MACDONALD, JR.

1st Lieutenant
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Lieutenant Macdonald is a graduate of Lehigh University as an industrial engineer. Following his graduation, he became associated with Carrier Corporation, working in various capacities as application engineer, in the construction department, as sales engineer, and finally before entering the Army, as coordinator of air conditioning sales in the munitions industry.

ARSENAL

POWDER AND SHELL PERFORMANCE

AIR conditiong has gone to war in many phases of our armament program. Food preservation in storage houses and on ship board, machine shops, airplane factories, chemical plants, blast furnaces, mines, instrument and tool companies, plastic industries, and munitions plants are only a partial list of the industries which are using air conditioning. Each of these industries has installed air conditioning to control quality, increase production, control processes, and improve working conditions; the industrial advantages of each item having already been proven over and over again during the last twenty years of peace.

Each of the above war industries, together with many others, is just an expanded peace time enterprise re-tooled to meet the war effort, with the exception of the munitions industry. The munitions industry is only large during war time, and during peace time it shrinks back to the research laboratories and pilot plants where the art is kept alive for our security. The munition engineers, however, study all industries to keep abreast of the modern industrial developments.

A good example of how progressive our munitions engineers are took place away back in the last war, when they recognized the needs for and the advantages of air conditioning and applied it satisfactorily to the manufacture of time ring fuzes. Since that time both the air conditioning and the ammunition industries have progressed with modern industrial strides.

Now in World War II the two industries are again working together in an attempt to improve the quality and production for our armed forces.

In this article the problems of the control of air in the munitions plants will be studied in regard to its necessity, engineering problems, equipment, selection, and safety.

The Complete Round

In order to have a clear idea of the nomenclature of a complete shell, together with the names of each part and its functioning, let us study the following complete round drawing, as shown on the next page.

Artillery Primer: The artillery primer is a brass tube perforated throughout its length with many small holes. Each of the holes is sealed with a waterproof paint. Within the tube is a charge of black powder, and in the base of the tube is located the percussion element. The flash from the percussion element ignites the black powder which in turn blows through the perforations in the tube to ignite the propelling charge.

Propelling Charge: The propelling charge is usually smokeless powder and is contained within the shell case. The smokeless powder, upon burning, produces very high gas pressure which forces the shell from the gun with sufficient velocity to carry it to the target.

Shell Case: The shell case is used to hold the propelling powder. In fixed ammunition the shell is attached to the shell case so that both can be loaded into the gun at one time.

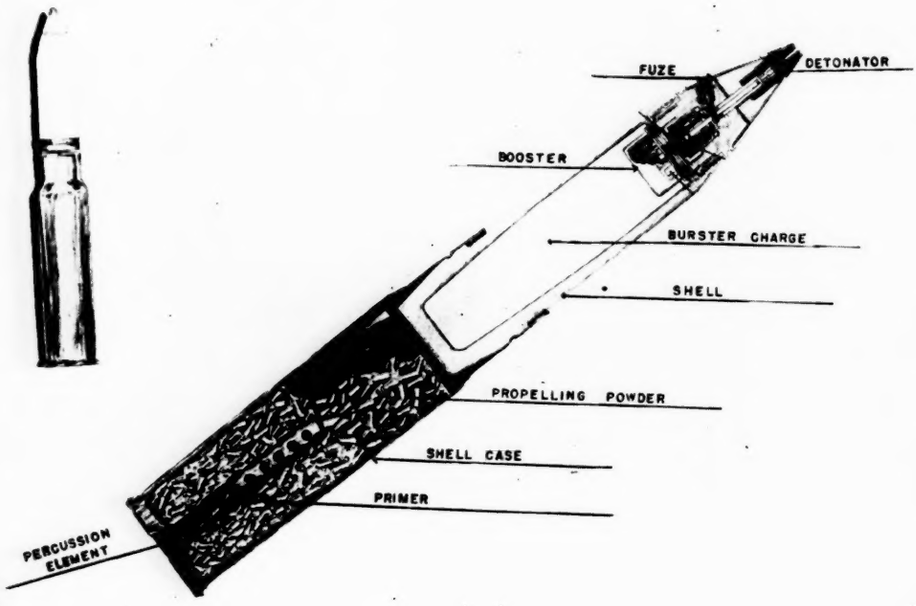
When larger types of shells are required, semi-fixed ammunition is used to reduce the weight and bulk size for handling; and since semi-fixed ammunition consists of a shell case complete with its propelling powder and a separate shell, both are loaded into the gun separately.

Shell: Shells are of two principal types, solid shot and high explosive. The shell shown in the sketch is high explosive as it has a powder charge within it which causes it to explode upon contact with a target. Solid shot does not explode as it contains no explosive charge and, therefore, is used for piercing action.

Explosive Charge: There are a number of explosive charges used in shells. One of the most common is TNT. The explosive charge is exploded by the ignition from a fuze.

Fuze: Fuzes are of many types—impact and time are typical examples. An impact fuze is one that sets off the explosive charge upon contact with a target. Basically, it consists of a firing pin which stabs a delicate initiator—a detonator or fuze primer. The flame from the initiator ignites a booster charge, usually tetryl, which in turn has sufficient power to detonate the explosive charge. The whole explosive train must function in about one-thousandth of a second.

Time fuzes are those which cause the shell to explode after a given lapse of time. The time is either measured from the time a projectile is



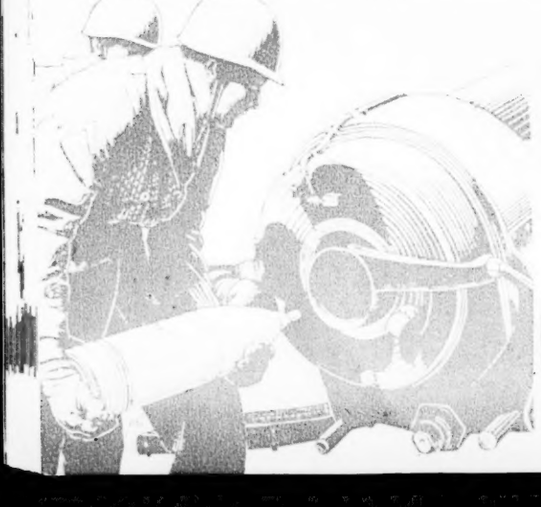
A complete round showing the various integral parts which go to make up the shell.

fired from a gun or after the projectile contacts the target. The first type, where time is measured from the gun, is referred to as a *time* fuze; and the burning time can be pre-controlled from one second to many seconds. This type of fuze is commonly used in anti-aircraft barrages or barrages against enemy personnel. Fuzes usually are referred to as the *delayed action* type when the time is measured after impact.

Time fuzes are commonly made in two types, mechanical and powder train. Mechanical time fuzes are controlled by watch mechanisms. In the powder train type, the time is controlled by the time required for a powder train of fixed length to burn. In both types of fuzes the burning time is pre-set by the gun crew.

Delay types of fuzes are usually a combination of impact fuzes and time train fuzes except that the timing is set at the time of manufacture and not by the gun crew. Delay fuzes give a shell sufficient time, for instance, to pass through a ship's deck before exploding. The time is measured in fractions of a second.

Modern warfare calls for many types and sizes of shells, bombs, and fuzes. The one illustrated is just one of the many types and has been selected as it shows most of the typical parts and mechanisms.

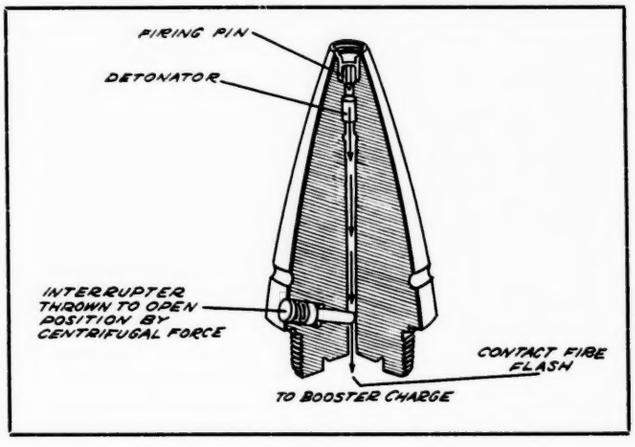


Sectional view of an impact type of fuze which sets off the explosive charge on contact with the target.

Air Conditioning and the Complete Round

Percussion Elements. The percussion element part of an artillery primer is the initiating element that ignites the primer by blow from the gun's firing pin. It is composed of a small drawn brass cup into which an accurately weighed powder mixture is charged. A special type of sealing paper is pressed on top of the powder charge, and a brass cover called an anvil is expanded by pressure into the cup over the paper.

Cleaning of Metal Parts. All metal parts are drawn in the metal shops on mass production machines. The machine operations leave traces of oil and grease on the metal parts which react unfavorably with the chemicals used in the sensitive powder mixture. Therefore, all parts must be washed and cleaned of all foreign matter before loading.



The machined metal parts are placed in perforated trays which are dipped into tanks containing the cleaning solutions and then are rinsed in clear water. After rinsing, the trays are placed in an air drier where all free moisture is evaporated.

The driers are of the forced air type with the temperature maintained between 180 F and 200 F. Self-contained types of steam valves prove very satisfactory for controlling the drier temperatures.

Artillery Primer. Artillery primers consist of a brass tube approximately ½ in. in diameter, perforated with 3/16 in. noles. The length of the tube varies from 2 in. to 10 in. The tube is lined with paper and the holes are then sealed with a paint to make the assembly vapor-tight. The tube is filled with black powder and the percussion element is inserted and sealed into one end of the tube. The primer is ignited by the percussion element and in turn the primer ignites the propelling powder of the shell.

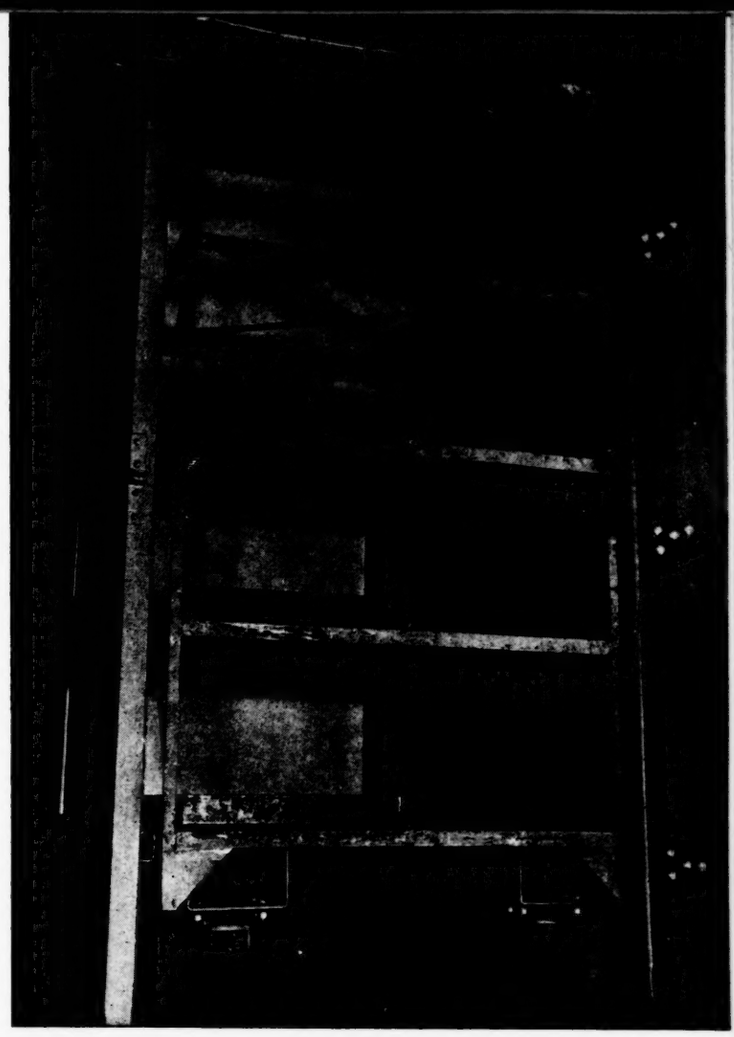
The drying of the paint in the flash holes is an exacting operation, since the paint in each hole must be dried from the inside out without shrinking the paint away from the metal and breaking the vapor seal.

A truck type drier was developed with trays on each truck designed to hold each tube in a vertical position, yet allowing sufficient free area for vertical air distribution. Each truck holds 18 trays of primers —six trays on each of three levels, each tray holding one gross of primers. The trays are filled by the paint dipper and then placed on the truck and moved into the first section of the drier, where 110 F is maintained and the air is distributed from a perforated ceiling down through the trucks at a high velocity. The return duct is located on the floor. By manual regulation, the amount of air re-circulated and exhausted can be controlled. The heating unit is a standard blower type unit heater.

When the solvents have been removed from the paint, the trucks are moved into the second stage of the drier where air which does not exceed 90F is blown over the surface of the paint. The same type of air distribution is used in each stage of the drying treatment. This treatment quickly gives the paint sufficient surface hardening to facilitate handling during the powder loading operations.

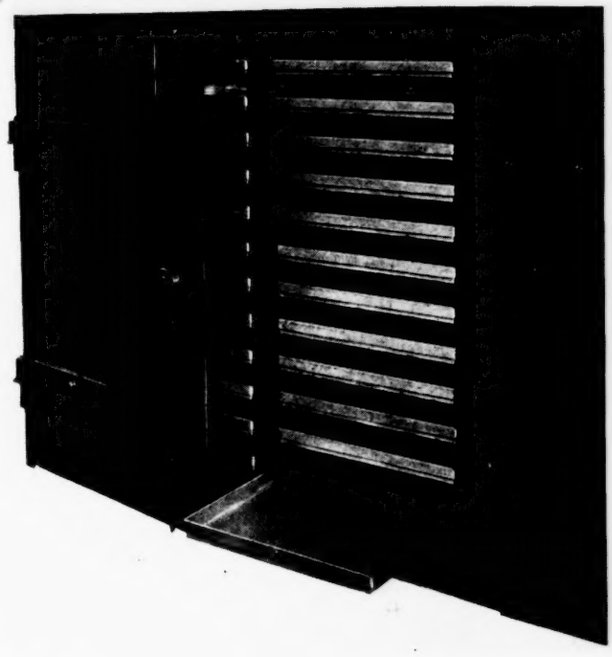
Black Powder Drying. Drying of black powder for artillery primers is as important as the drying of powder for fuzes, delays, and other igniting charges. The moisture content of black powder controls its burning rate, the more moisture the slower its burning rate. Moisture content is usually maintained below ¾ of 1% by weight to procure uniform burning.

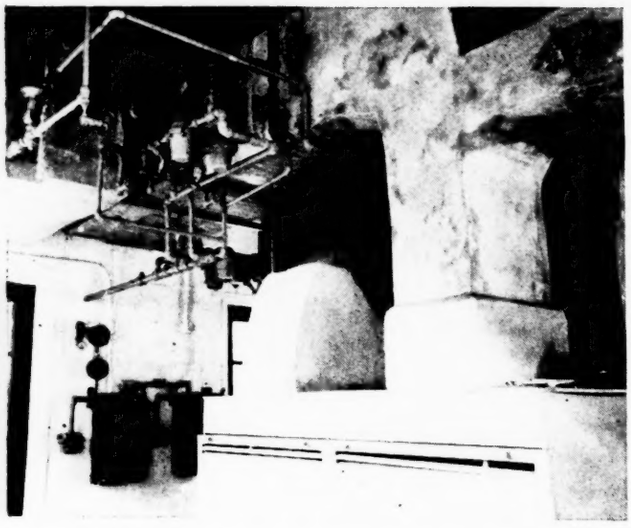
By use of a special drier in which there is control of air circulation, and also the temperature and moisture content of the air, a fixed drying cycle of six hours when drying to 0.4% moisture content has been made possible.

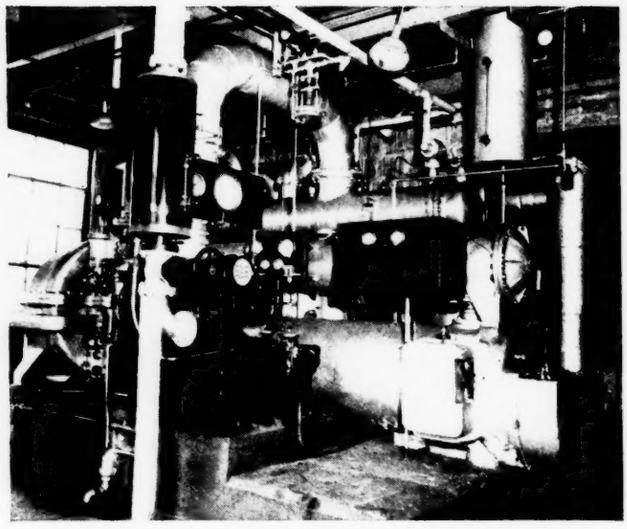


Truck type of dryer used for drying paint in painted holes of artillery primers. Warm air enters through the perforated ceiling and circulates down through the trays at high velocity leaving through a return opening at the floor.

Drawing compound is removed from metal parts by immersing filled trays in cleaning compound followed by rinsing in warm water and drying in the oven shown. Drying temperatures of 180 to 200F are used.







(Left) A silica-gel unit supplemented by reheaters supplies warm dehydrated air to the black powder dryers. Explosion-proof starters from the conditioning unit can be seen on the wall. (Right) Centrifugal type refrigeration unit driven by a steam turbine furnishes chilled water at constant temperature for the solvent recovery units.

High temperatures with low moisture content was a natural for a Silica Gel dehydration unit application. This unit naturally furnished air at low moisture content with a discharge temperature of 120F to 130F due to an adiabatic transformation of latent heat to sensible heat. It was only necessary, therefore, to add re-heat to further elevate the supply air temperature to the required degree.

Black powder is very dusty and is very sensitive to friction; therefore, 100% fresh outside air is used, with none of it recirculated.

All door panel frames and door fastenings are of brass to prevent sparks from steel-to-steel contact. All the insulated panels are electrically grounded and the seams sealed so that there are no cracks in which powder might collect. The internal fittings and ducts are so arranged that they can be thoroughly cleaned of powder by means of a hose.

An interesting feature of this drier is that all air conditioning equipment is housed in a building separate from the drier so that there is no danger of powder dust getting into the equipment and causing a fire or explosion.

The powder is carried in moisture-proof containers to the primer loading hoppers. The hopper now is not air conditioned as the time interval from opening the can to sealing the primer is so short the moisture pick-up is negligible.

Smokeless Powder. Smokeless powder is one of the most common types of propelling powders, its principal advantage being that it does not give a gun position away upon firing.

Chilled water is used to condense solvents such as ether and alcohol from the powder after pressing. The solvent is condensed on water cooled coils from the solvent-laden air which is circulated over the coil.

Smokeless powder is non-hydroscopic and, therefore, a water wash can be used to remove the last traces of solvent. After the solvents have been washed from the powder with water, the powder is transferred to special cars and any water remaining in the powder is removed by drying.

The cars are constructed with a perforated bottom with an air supply plenum under the powder bed to give uniform air distribution. In the dry house, an air duct is connected to the plenum and an exhaust air hood is dropped over the top of the car. Each car holds approximately one ton of powder. Heated air at high velocity is forced through the car from the bottom air distribution plenum. The air is then exhausted through the hood on the top of the car.

During cold weather, part of the exhaust air is reused to save steam by introducing it again into the supply air system at the supply fan inlet. This saves on steam required to heat the outside air supplied. The recirculated air is not passed over any heater, all heat being applied to the clean outside air. This is done as a safety precaution.

Each drying system can handle from one to six cars depending on the manufacturing rate. Since the air quantity and static pressure vary to such a large extent from partial to full load, a non-overloading type fan is recommended.

Tetryl. Tetryl is a nitrated explosive used in boosters and detonators. As in other nitrating processes, refrigeration is used to control the heat of chemical reaction and the quality of the product. The capacity of a kettle depends upon the rate of heat removal by the chilled water in the nitrator jacket.

Powdered tetryl is very light in weight and powdery when dry. Tetryl is normally pelleted before loading in much the same manner as druggist pills. The powder is, therefore, air dried in trays before pelleting. Drying trays are placed in tiers on trucks which are then wheeled into the drier chambers. The air is circulated horizontally across the trays at low velocity so as not to disturb the dust. Recirculated air can be used, providing it does not pass over a heating coil.

Projectile. Each type of projectile has a different steel requirement depending upon its ultimate use. The completed shell must be able to stand wide variations in temperature between the tropics, the Arctic, and the stratosphere. Temperature changes can produce cracks in forgings when local strains exist in the steel grain structure. Flaws are very dangerous as a cracked shell can very easily explode prematurely in a gun and ruin the gun and kill its crew. To insure against this condition, shells are given a shock treatment by heating and then cooling quickly in refrigerated water.

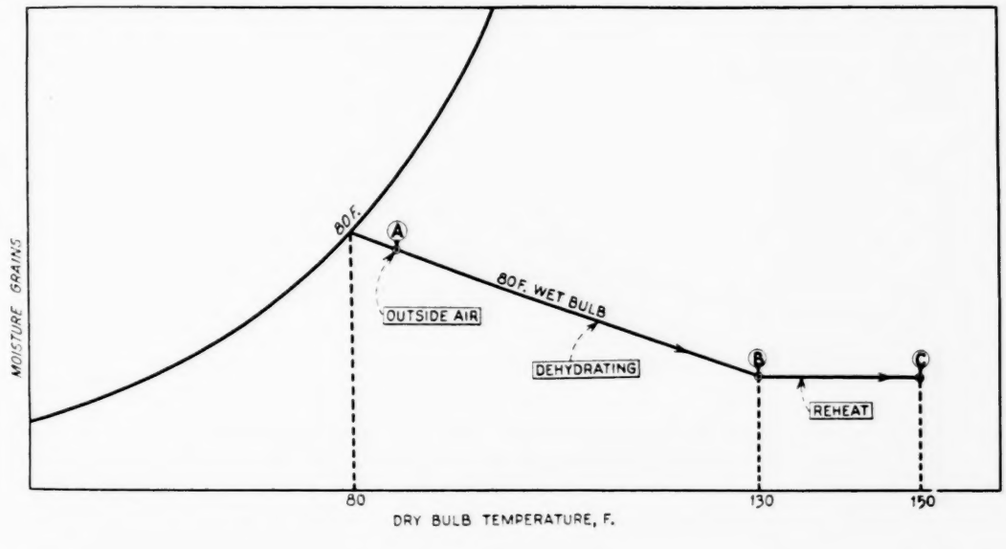
Fuzes. There are two types of fuzes and in the following paragraphs the time fuze and delay fuze will be discussed separately.

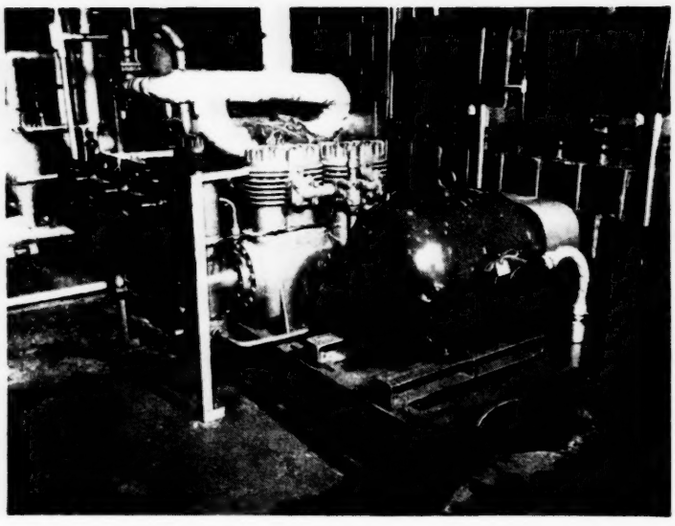
A *time fuze* is one that explodes after the lapse of a predetermined interval after it leaves the gun. This type of fuze is used for shrapnel against airplanes or personnel in trenches. There are two types used, (1) mechanical clock-work, and (2) powder train.

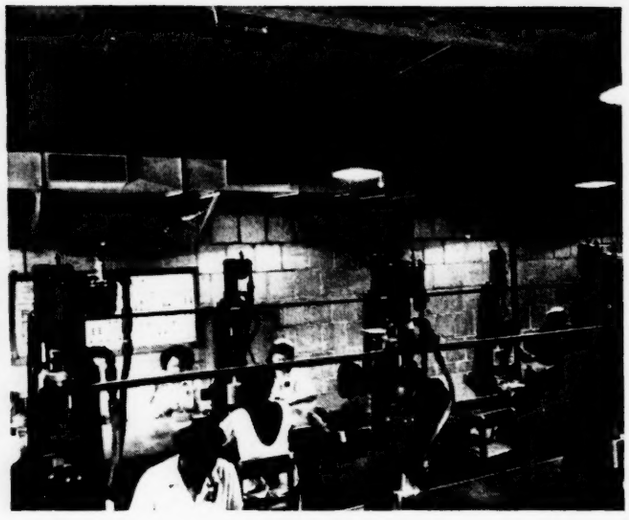
Black powder is dried in this eight-section unit. The dryers are placed back to back, four in a group. Brass hardware is used throughout to avoid possibility of sparks. A typical moisture-proof powder can can be seen.

Mechanical fuzes are made similar to watches, and close mechanical tolerances are required. Several of the mechanical fuze plants use air conditioning to control the perspiration of the operators so that the

Outline of psychrometric chart showing cycle of conditioning for black powder drying. Outside air enters dehydrator at condition (A) and leaves at (B). Reheat is added between (B) and (C) and air passes to the dryer at condition (C).







(Left) A duplex Freon compressor unit supplies the cooling effect for the conditioning of the fuze line shown in the photo at the right. (Right) Conditioned air entering through the duct outlets overhead maintains the necessary close temperature and humidity control for target fuze line operations. Safety is paramount in making munitions. Note the room cleanliness and safety roster on the wall.

salts from the perspiration do not cause corrosion on the metal parts.

The powder train fuze is one where the rate of burning of powder controls the time. The operation of the fuze is very simple, but great care is required in manufacture since accuracy of performance is measured in one-hundredths of a second.

An inertia metal plunger is released by the starting motion of the shell in the gun, called *set back*. The plunger strikes a fuze primer which in turn ignites the powder in the rings of the fuze. There are two rings in a fuze of this type into which black powder is compressed into annular grooves. These annular grooves do not form a complete circle but have a small land between each end of the groove to prevent the ring from burning in two directions.

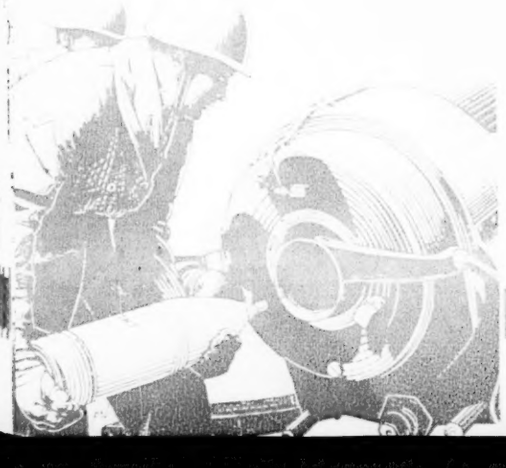
The fuze primer ignites one end of the powder train in the upper ring which is stationary in the fuze. The powder burns around the upper train until it ignites a black powder pellet in the lower adjustable ring which allows the flame to pass from the upper surface of the lower ring to its lower surface where the pellet will ignite the lower ring powder train. The lower ring is adjustable by rotation. The lower train burns until the flame hits a pellet in the metal base of the fuze which in turn passes the flame to the booster charge. The burning time is pre-set before loading the shell in the gun by turning the lower ring for longer or shorter time, the rotation determining the length of the powder train required.

In the manufacture of this type of fuze, air conditioning plays one of its most important roles. The powder must be dried as previously described. The powder is then conditioned to a fixed moisture content by spreading it on trays exposed to a room air condition of 70F and 40% relative humidity. The relative humidity must be controlled within 1% so that the powder moisture content can be controlled within 0.1% moisture content by weight.

When the powder has been conditioned to the correct moisture content level, it is taken to the loading room where it is carefully weighed and compressed under twenty-five tons pressure into the annular grooves of the rings. The rings are then transferred to a facing room for the finishing operations. This room is also conditioned, as the powder is still exposed. The pressed powder is vapor sealed in the conditioned facing rooms to keep out moisture after the loading operations are completed. The loading rooms are also maintained at 70F and 40% relative humidity.

The burning time of fuzes of this type can be controlled within a fraction of a second of the set burning time. The time accuracy is a direct function of the moisture content. More moisture gives a slower timing and less moisture a faster time. The room humidity must, therefore, remain uniform day in and day out so that all fuzes will be uniform.

Delay fuzes use delays to cause the explosion of the shell after impact with the target. They are of several types. This delay in some instances is used to allow a few one-hundredths of a second delay in



order for the armor-piercing shells to have sufficient time to penetrate armor-plate before exploding.

Air conditioning is used to control the moisture content of the delay powder pellets in the same manner as it is used in time fuzes.

Gage Rooms. When we consider the terrific strains placed upon a shell, the degree of manufacturing precision can be more easily understood. In the gun, for instance, a shell will, due to the rifling, receive an angular velocity of about 16,000 rpm and at the same time a linear acceleration from zero to 2700 fps, all in a fraction of a second. Anti-aircraft shells rise miles above the earth and pass through great ranges of temperature and atmospheric pressure. Despite the severe strains each shell must function and hit targets moving at 400 miles per hour.

All parts of a fuze and shell must be carefully gaged and tested for strength, hardness, and dimension to be sure of functioning under the wide range of conditions. Each part must be carefully gaged and tested to insure good quality. The standard master gages are, therefore, kept in constant temperature rooms. In these rooms the operating gages are checked and adjusted to maintain close tolerances.

Tracer Loading. Tracer composition is loaded in a cavity in the base of the shell. Usually the composition is pelleted into this cavity. The tracer mixture is ignited by the propelling charge in the gun and upon leaving the gun the composition burns fiercely and gives off a colored flame or smoke to aid the gunner in hitting the target.

The tracer composition must be weighed and blended accurately in a dry condition to procure uniform burning and color. Each ingredient is dried in a controlled air drier and weighed and blended in an air conditioned room.

Pelleting rooms are also conditioned in some cases to control the moisture content of the powder. Tracer blending, mixing, and pelleting rooms are small due to the dangerous nature of the work involved. Dust in these rooms causes an objectionable working condition. Air conditioning helps greatly by changing the air often enough to hold the dust level at a low point. The normal room conditions are 80F with a relative humidity of 35% to 40%.

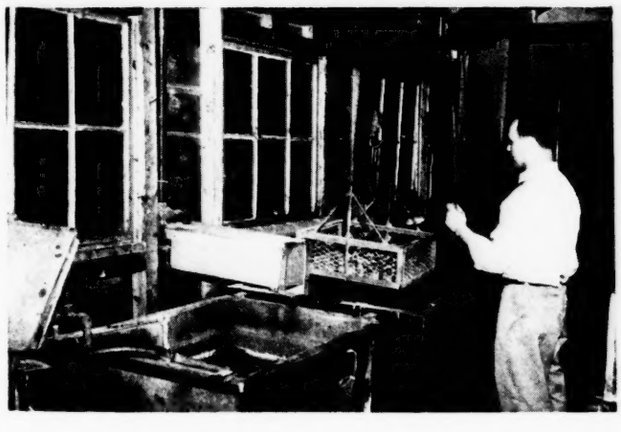
Problems of the Air Conditioning Engineer in the Munitions Industry

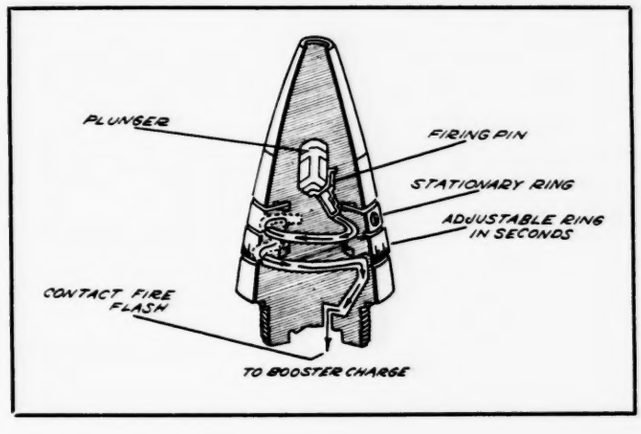
In all probability the air conditioning engineer has more problems to consider in system layouts in the munitions industry than in any other. Each application has its own problems of layout, safety, design basis, control, and so forth. In order to design the correct system, safety must be given first and foremost consideration, as failure to recognize the hazards invoved can easily cause a serious accident with probable loss of life. Secondly, the system must be able to furnish service with 24-hr operation with the minimum of maintenance and deliver exacting temperature and humidity conditions.

A complete survey of conditions required must be made with pains and thought. The following is a list of items to be given special emphasis:

1. Complete drawings of buildings noting
   (a) Which walls are explosion proof and not, therefore, to be pierced by piping and ducts;
   (b) Type of insulation to be used, both for temperature and moisture seals;
   (c) Whether windows are double or single;
   (d) Type of roof—permanent, or light "blow-off" type.
2. Services available:
   (a) Steam pressure,
   (b) Electric current,
   (c) Where can electric motors and switches be located?
   (d) What kind of motors or starters? Explosion proof or standard?

(Left) Shells are given a shock treatment to reveal dangerous flaws by heating and then cooling quickly in refrigerated water. (Right) A typical time fuze in which time interval between discharge from gun and moment of burst is preset by means of adjustable ring.





(e) Water temperature, pressure and source of water (purity, hardness, and so forth).
(f) Is compressed air suitable for controls?
(g) What type of heating is provided?

3. Internal load:
   (a) Maximum number of people (not average);
   (b) Lighting load. Are lights within room or shining in through windows?
   (c) Motor load hp, jack shaft hp load, load factors, hydraulic press hp.
4. External load:
   (a) Extremes of weather conditions, not conditions used for comfort systems.
5. Safety requirements:
   (a) Where can equipment be located?
   (b) Type of controls, whether pneumatic or electric;
   (c) Type of electrical equipment required;
   (d) Where can ducts be run (if allowed)?
   (e) Can recirculated air be safely used?
   (f) Can recirculated air be taken through fans and over heater coils?
   (g) How will ducts, pipes, and equipment be cleaned and what provisions should be provided?
   (h) Will the chemicals and dust affect the controls and equipment by corrosion?
   (i) Type of refrigerant allowed.

From the above survey the air conditioning engineer can properly design a system or advise his customer of conditions that cannot be met. For instance, one of the problems encountered in most installations is the best method of preventing moisture condensation in winter on the ceiling, walls, and windows. In some types of construction, condensation cannot be eliminated and gutters must be installed to collect the water.

Steam pressure is often available at 20 lb or more outside the building, yet due to safety rules only 5 lb pressure is allowed within it. The lower pressure, however, gives better heat control although more heating surface is required.

Normally electric disconnect switches must be located outside a building, and all other switches must be located within an equipment room. In explosive buildings, no electrical equipment is allowed in a room where powder is present.

The water supply at munitions plants is often corrosive, dirty, and hard, due to its source. Sometimes it is advisable to use evaporative type condensers because of the poor water supply or the amount of water required.

All systems should be designed to take care of widely varying internal loads and yet maintain the required temperature and humidity. It is not safe to discount loads in munitions installations as the rate of production and type of work can change over night; be generous.

The outside design weather conditions should be figured on a maximum basis as the small difference the outside design conditions make in the cost and selection of equipment is poor economy. The day on which outside conditions reach a maximum may be the day that the production output is critical. This is an important deviation from normal comfort air conditioning practice.

On safety requirements the following should be noted:

(1) The air conditioning equipment will normally be located outside of the conditioned space in an apparatus room;

(2) Pneumatic controls are normally used, as they do not spark on regulating, and afford close, accurate modulation;

(3) Duct work is not usually allowed to pass from one explosive room to another regardless of whether or not outlets are taken off in each room. This restriction applies because of the danger of explosive dust carrying a fire from one room to another.

(4) Recirculated air is not normally recommended when more than one room is supplied from a unit. All outside air is required or else separate air handling units are necessary as this prevents a fire from progressing from one room to another. Many bad fires have been caused by faulty layout of duct work. Fire dampers and water screens cannot be relied upon, as fire dampers do not act rapidly enough and the worth of water screens or traps is only proportional to the maintenance given them.

(5) Ample clean-out doors should be installed in the equipment and duct work.

(6) Water sprays, humidifiers and wet coils are a safety precaution when handling black powder. Water destroys black powder as an explosive, even after the ingredients are dried. The same does not hold true in some pyrotechnic compositions and incendiary compositions. Water in the latter compositions causes a more violent reaction. Water piping should be kept out of pyrotechnic composition rooms as a water leak during a fire would cause a more violent reaction.

(7) The question as to the advisability of filters should be carefully studied. There is little question as to their desirability in the outside air duct when powder dust will not accumulate or in rooms not contaminated with powder dust. In return air ducts,

however, filters can become very hazardous when powder accumulates on them. The amount of explosive pick-up varies and there is the chance of human error in deciding how often to clean the filter and in judging the amount of powder present.

(8) Some of the chemicals present in the dust which circulates in munitions factories corrode the control instruments, unit casings, and copper coils. The characteristics of each chemical in solution should be studied as to its effect on the different metals it contacts in the air conditioning equipment.

(9) Explosion-proof electrical equipment is normally required, but often it is possible to use standard equipment by selecting suitable locations. This decision rests with the plant's safety department.

The Safety Divisions of plants should be consulted, as they can aid in the selection of the correct layout and equipment from the safety view point. Munitions are made to explode but explosions must be kept out of the plants which manufacture them.

Typical Equipment

The equipment that is required for a satisfactory air conditioning system does not differ from the conventional standardized equipment normally used. The success of the layout depends almost wholly upon its selection and choice.

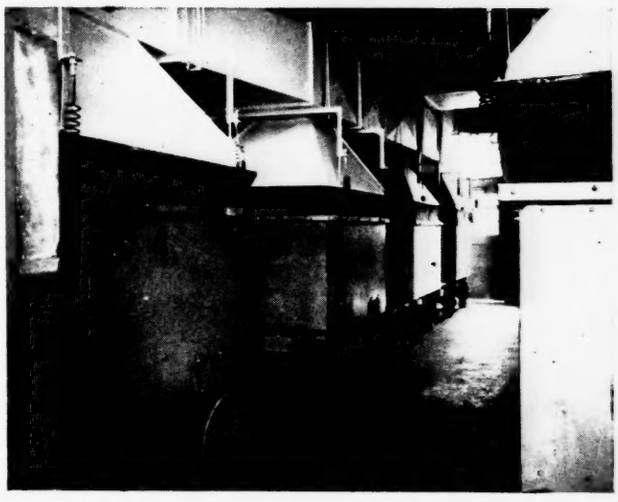
Air Handling Units. Typical standard self-contained air handling units lend themselves well to the munition applications. The fan inlets should have a copper ring inserted to protect against the danger of sparking should the wheel hit the fan housing. This requirement is only necessary, however, in special applications. The unit should include drip pan for condensation, direct expansion coil or chilled water coil for condensing the moisture and cooling the air spray type humidifier, water heater, recirculating water pump, reheater, and fan.

Refrigeration. The refrigeration unit can be of either the DX Freon type or water cooling type, depending upon which type is dictated. The standard sizes of equipment meet most applications.

Controls. Air conditioning is used in the munitions industry as a means of controlling the quality of the product. The controls installed for the units controlling the temperature and humidity must be selected with great care because the temperature and humidity directly control the product. Pneumatic controls are normally used due to their close throttling characteristics and their safety advantages.

From the safety point of view, pneumatic controls are advantageous in that they do not require electric switches or contacts, and control conduits do not contain any electric wiring, air being the motive power.

Many of the air conditioned rooms have a high dust count which interferes with the operation of control instruments. Pneumatic control instruments, however, are of a more or less self-cleaning type in that air is discharged from the instrument, thus cleaning off the control ports.



Special trucks used for drying smokeless powder. Heated air at high velocity is forced through the car through a perforated bottom and drawn off through the hood connection at the top. Each truck holds about 1 ton of powder.

Each control instrument must be selected to give continuous service with little maintenance, and at the same time maintain its calibration. Humidity controls usually give the greatest amount of trouble, and should be of the type which is not subjected to distortion of tension mounting, such as a hair or membrane. A non-tension element such as Bi-wood, although not so sensitive as hair or membrane but having the same reaction in multiplying mechanical motion, seems to stay in calibration and is not affected by surface deposits of powder and dust. The ruggedness of Bi-wood stands up under fairly rough handling, such as the continuous cleaning of control instruments to remove powder dust.

Dampers in the duct system should have non-metallic hinges so as not to cause sparking.

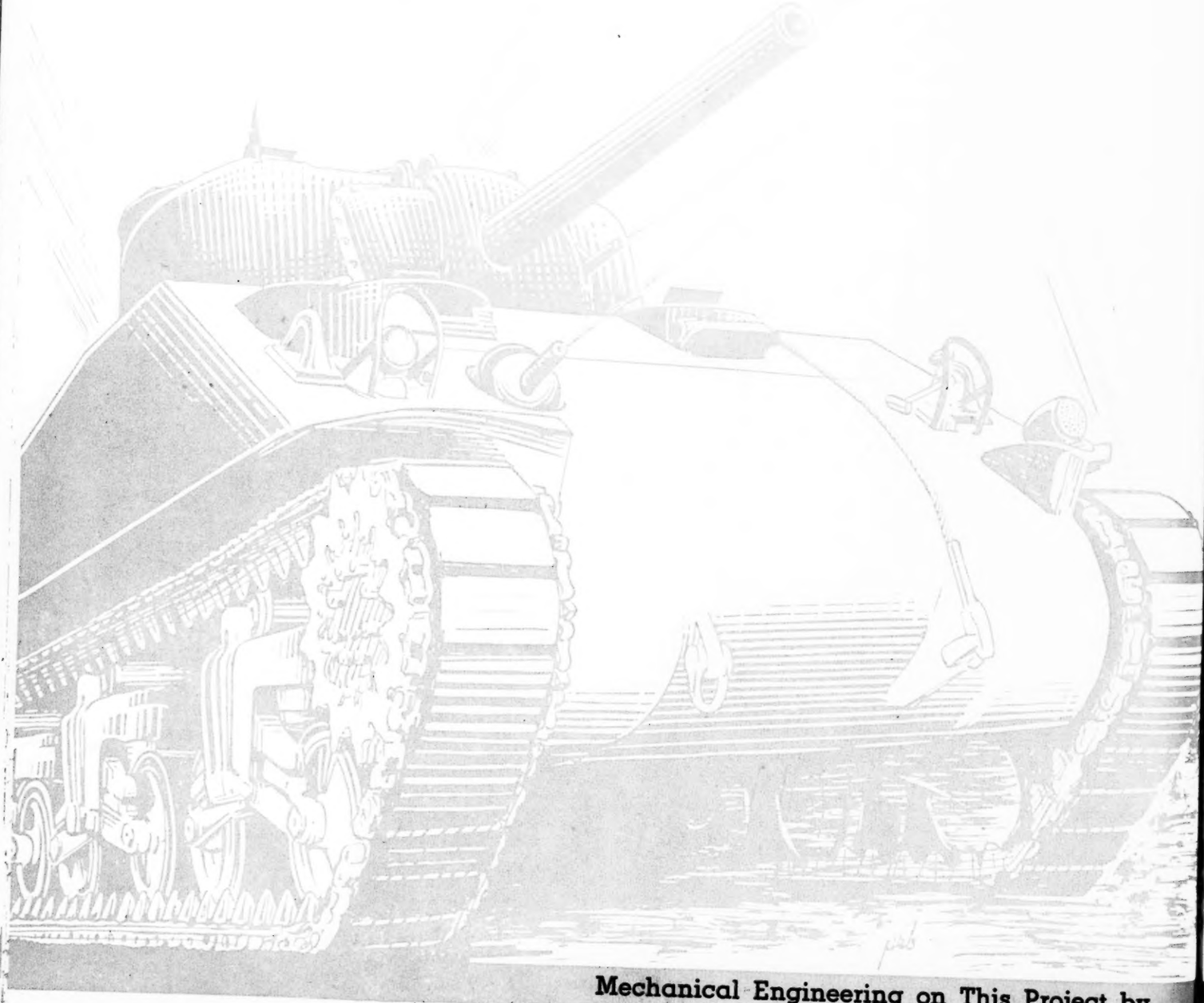
Air Outlets. Air distribution in rooms where powders are pressed must be uniform and very accurately controlled so as to disturb the powders as little as possible. Where outlets of the type which is completely adjustable for horizontal and vertical distribution of conditioned air are very much desired, it must be remembered that the items manufactured in an air conditioned room may change from day to day or week to week and the flexibility of the air conditioning units and air distribution system must be able to take care of this condition.

Conclusion

In summing up, it can be stated that a successful air conditioning system is dependent on engineering knowledge of the equipment, and knowledge of the problems of producing munitions. The success of the full installation depends upon the initial engineering, as sound basic engineering involves not just the control of temperature, humidity, and air motion, but the quality of the product and the safety of our Ordnance workers.

SYMINGTON-

INSTALLS SIMPLE BUT EFFECTIVE



Mechanical Engineering on This Project by

GOULD CORP.

SYSTEM IN TANK CASTINGS FOUNDRY

By ALLEN S. CROCKER
Mechanical Engineer, Rochester, N. Y.

A NEW foundry unit known as Plant B, recently completed by the Defense Plant Corporation for the Symington-Gould Corporation and placed in production in an east coast state, has an extremely simple but effective heating and ventilating system. Like so many other similar installations rushed through to completion as part of the emergency war building program, the design of the system was, to a considerable extent, necessarily dictated by the need for saving critical steel and other metals, and by the narrowed choice of available equipment. Important castings for mechanized equipment for the Army Ordnance Department are being produced here, and it can be said that comfortable ventilation and heating of the working spaces aid materially in keeping production at a gratifying level.

Building Construction

The foundry proper consists of two bays about 300 ft long with a total width of 130 ft. A two-story lean-to 24 ft wide, containing locker and wash rooms, foundry offices, compressor room, inspection department, and stores, extends along one long side and a loading shed about 20 ft wide parallels this. On the other side of the building, and at the two ends, walls are of brick to a height of 9 ft from grade and above this are almost continuous bands of steel sash windows, separated by steel plate runners. The exceptionally large glass area thus provided gives a foundry well lighted by daylight. The foundry bays are of monitor construction, about 46 ft high exclusive of monitors. Roof is 2½ in. concrete poured in place.

Exhaust Ventilation

Positive mechanical ventilation either for normal operating periods or during blackouts is provided by eleven 42-in. diameter power-driven ventilators at the tops of the two monitors, and two 48-in. diameter unit ventilators in the main roof near one end of the building. Each of the 42-in. ventilators handles 19,500 cfm and the 48-in., 28,800 cfm. Each ventilator has a starter within reach of the floor on the column nearest to it.

Outside Air and Heating

Several factors entered into the selection of side wall unit ventilators of the type shown for bringing in heated fresh air as make-up for the fume-laden air exhausted.

A central fan system with underground distributing ducts was at first considered but was rejected in favor of the wall units because of the difficulties of avoiding heavy concrete foundations under various machines and furnaces, and because of the necessity for utilizing all possible floor space for manufacturing; also important in the decision were the greatly lower first cost of the unit ventilator installation and the definite assurances of delivery of equipment.

These units, some fifteen in number, are suspended with the bottom of the heater casings about 15 ft above the floor, and all but two have square bottom discharge nozzles, with directional adjustable visors attached, extending to within 10 ft of the floor. Four multiblade blower wheels, mounted on a common through-shaft, force the air through these nozzles, one wheel for each nozzle. The unit ventilators have top inlets, with side-passes, through which some of the fresh air can be by-passed around the heating coils. The discharge air temperature is controlled by the operation of by-pass dampers, and these are actuated by a thermostat in the discharge air stream.

Building design dictated the style of unit ventilators used. Steel columns along each side wall extend inward 19 in. from the inner face of the masonry and this made it necessary, in

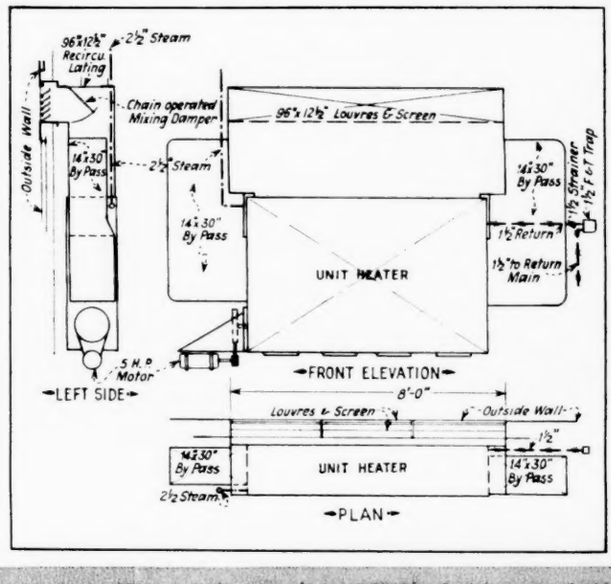
Hooded fresh air intakes to the unit ventilators are shown in this side view of Symington Gould's foundry.

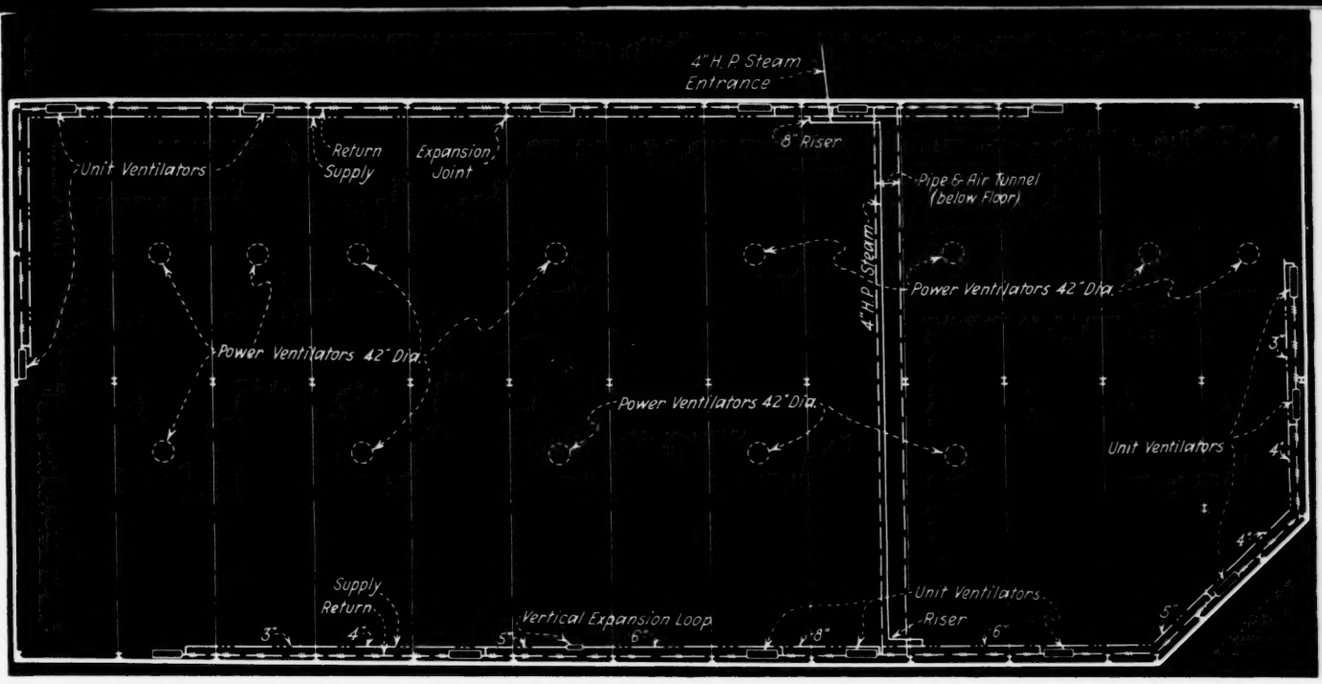
order to have full-width crane operation throughout the two bays, to use unit heaters that extended out from the wall face no farther than this 19 in. This limitation of heater depth made it impossible to use a back by-pass type, and the side by-pass, therefore, was used.

The by-pass idea was decided upon instead of thermostatic control of modulating valves in the steam lines leading to the various heating units because this arrangement was thought to be somewhat safer from possible freezing. However, there resulted another complication, which proved to be not serious but perhaps interesting enough to be mentioned here, when upon test it was found that the temperature of the air discharged from the two inner nozzles of the units was several degrees higher than that from the two outer ones. This was due, of course, to the latter handling more by-pass air. The condition was not particularly objectionable except in that it required locating the thermostats in the side nozzles to make sure that air coming from them would not be too cool for the comfort of any worker directly exposed. The resulting slight overheating of the center nozzles is negligible in its effect on steam consumption, and rapid diffusion makes any temperature differences imperceptible at the floor line. The condition could have been overcome entirely, if necessary, by extending the entire casing down as a mixing chamber with nozzles located at the bottom of the chamber, instead of using the long individual nozzle drops as was done.

Two of the unit heaters, on opposite walls of the foundry, previously mentioned as not being equipped with nozzles, do have these solid casings, and these extend to the floor and discharge into a pipe tunnel 5 ft wide × 6 ft 6 in. deep running beneath the floor laterally across the 130 ft width of building near the center. Air passes from the tunnel into a vertical concrete air shaft which rises above the floor to a height of about 10 ft and discharges the

Details of a typical wall type heating and ventilating unit. Each unit has four blower wheels mounted on a through-shaft.





Plan at the roof line of the new foundry building, showing layout of roof power ventilators and steam supply and return lines.

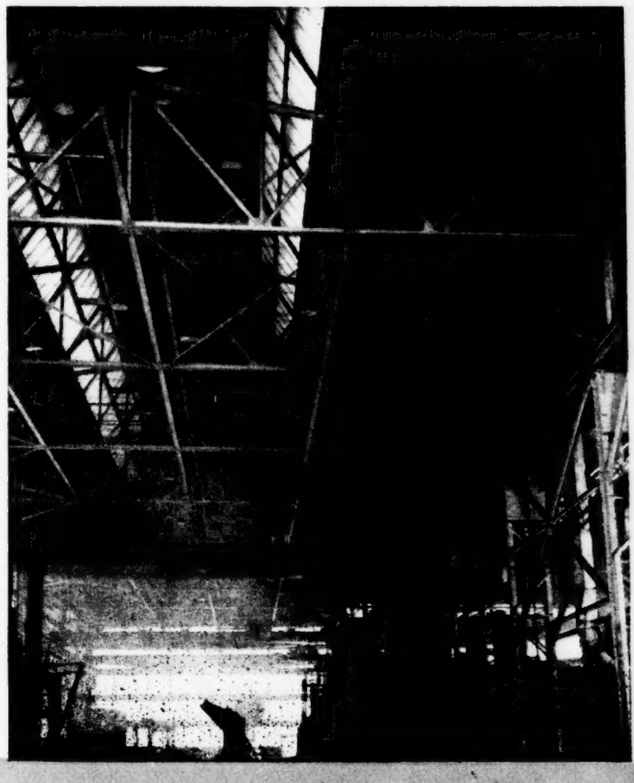
air laterally in all directions through registers. This is located at a central floor point where need for ventilation is greatest, and it serves to introduce fresh air directly into the area, in that way supplementing the carry-across from the wall units.

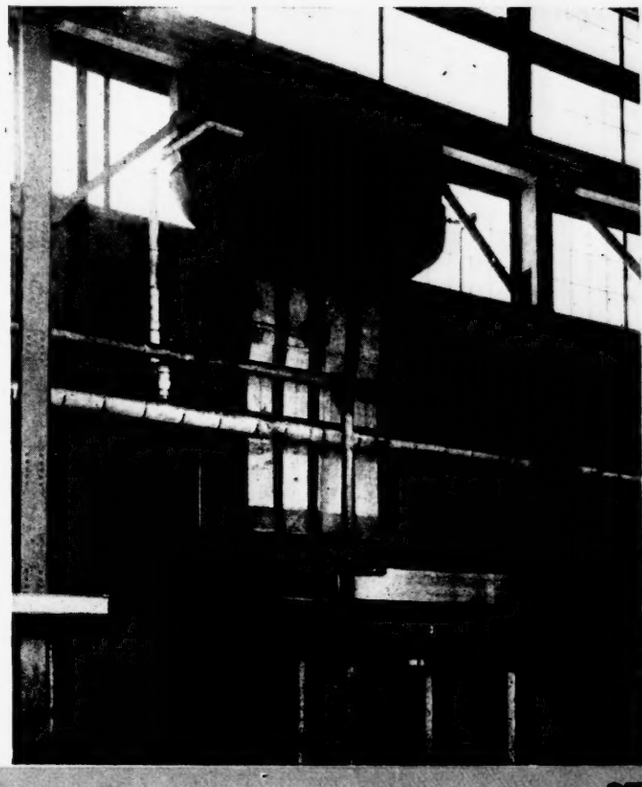
Capacities

The fifteen unit ventilators each supply 10,300 cfm of outside air, or a total of 154,500 cfm. This is 5.23 air changes per hour. The roof ventilators can exhaust a total of 272,100 cfm. It was not intended to run all ventilators in winter or when the building is closed up. Hand dampers permit recirculating air through unit heaters, in case of plant shutdowns or for other reasons. The steam mains and returns were all run near the outside walls and kept within the 19 in. mentioned by threading through the bracing members of the structural columns.

William G. Kaelber & Leonard A. Waasdorp, Rochester, N. Y., were the architects for the project.

(Left) General view of one bay showing one of the 13 Powermaster monitor ventilators, having a total exhaust capacity of 272,000 cfm. These are controlled by manual starters on adjacent columns near the floor. (Right) Closeup of one of the Dunham unit ventilators. Fifteen such units each supply 10,300 cfm of outside air, with heater by-pass dampers automatically operated by the Barber-Colman duct thermostat, controlling the delivery air temperature.





GENERAL STEEL

APPLIES DIRECT-FIRED HEATERS IN

By ERIC F. HYDE
Mechanical Engineer
Giffels & Vallet, Inc., L. Rossetti

A new steel foundry designed specially for mass production of large steel castings has just been completed in the Middle West. The entire plant production is for war use.

General Steel Castings Corporation agreed to undertake the job of making these large castings if Defense Plant Corporation would build the new foundry. Giffels and Vallet, Inc., Architects and Engineers of Detroit, Michigan, designed the plant, which was built in record time and is now in production.

The group of buildings comprising this plant consists of an Office Building, a Machine Shop, Heat Treat Building, Foundry, Chemical Laboratory, Oil Heating House, Store Building and Pattern Shop. The Machine Shop, Heat Treat Building, Foundry, Chemical Laboratory and Oil Heating House are connected together under one common roof. The other buildings are separate structures.

The purpose of this article is not to tell of the process of manufacture of these castings, interesting though it is, but to describe the method of heating and ventilating these enormous structures. Incidentally, it will tell of some of the problems which had to be met and solved in the development of these systems.

First and foremost was the problem set up by the limitations on use of critical materials. This practically eliminated the use of boilers and of the usual steam heating systems. Instead, large unit heaters of the direct-fired type were decided upon to heat the larger structures.

Choice of Fuels

Next was the problem of the kind of fuel to use. With direct-fired units scattered throughout these buildings, coal was more or less out of the question because of the nuisance of handling the coal and ashes. Natural gas was the first choice of a fuel for these units, but this proved to be out of the question also on account of (1) the lack of facilities for manufacturing and transporting of the required amount of gas to the plant, and (2) the restrictions on gas.

By the process of elimination, oil was therefore chosen as the fuel, in spite of the limitations upon its use also. The plant moreover is very favorably situated for the use of oil since it is located on a pipe line direct from the Texas oil fields to points north. Grade No. 3 oil was selected because of the ease with which it can be automatically controlled.

Buildings and Heat Requirements

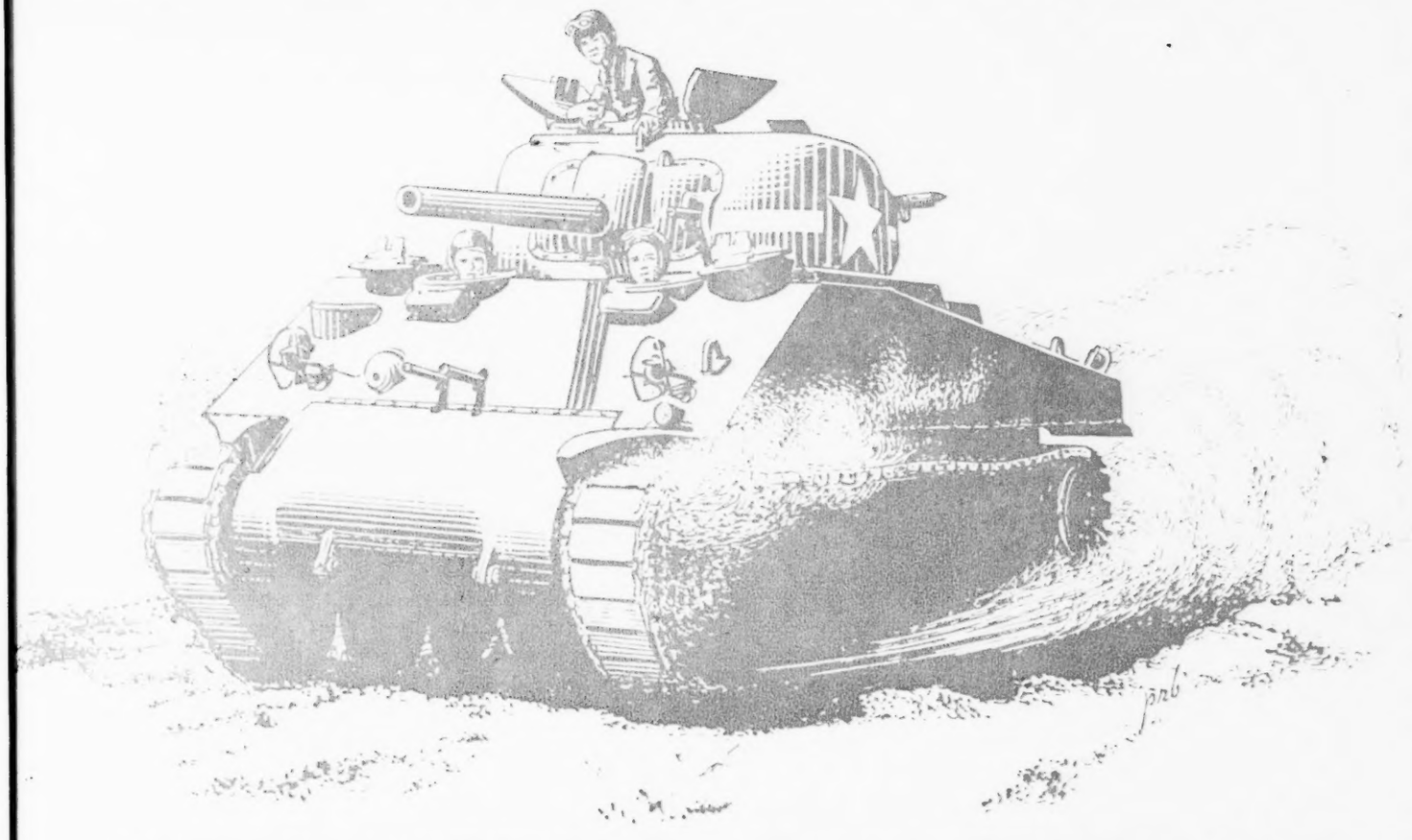
The Foundry of this group of buildings is 1850 ft long, 300 ft wide and 60 ft high. The Heat Treat Building is 1,530 ft long, 270 ft wide and 48 ft high. The Machine Shop is 1,650 ft long, 225 ft wide and 48 ft high. All three buildings are heated by large, welded steel type, oil-fired unit heaters. The heat loss of these buildings, including provision for ventilation air, totals 117,000,000 Btu per hr. The heating units servicing the large manufacturing spaces each have a capacity of 1,500,000 Btu per hr and 14,000 cfm. There are 78 of these large units in all, and they are located on the floor adjacent to the outside walls.

Oil-Fired Heaters

The unit heaters selected for these buildings are manufactured by the Dravo Corporation. They consist of a welded steel combustion and radiator section, oil burner with refractory lined combustion chamber, blower unit located at the bottom of the heater, and an induced draft fan. Automatic controls are a part of each unit and consist of a thermostat in the return air chamber and safety controls to shut off the oil valve in case of flame failure, power failure, and high discharge temperature. Air is delivered through nozzles in a horizontal direction from the top of the unit, and the air enters the unit at the base.

CASTINGS CORP.

PLANT MANUFACTURING TANK CASTINGS



The one unit heater for the Machine Shop offices and toilets is similar to those of the Foundry, Heat Treat and Machine Shop buildings, except that its capacity is only 1,250,000 Btu and 12,000 cfm. Distribution of heated air to the offices is through a system of sheet metal ducts. Provision is made for fresh and recirculated air to the unit.

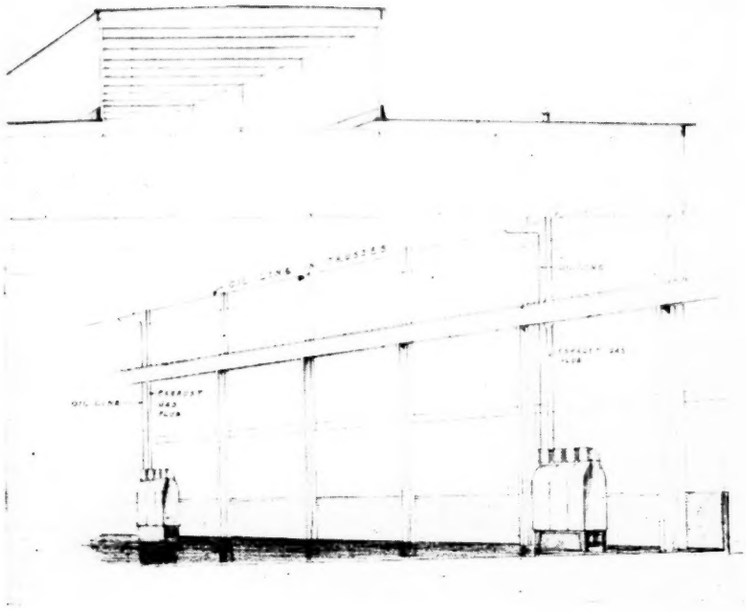
The four heating units for the Open Hearth office and toilets, for the Foundry office and toilet, for the Physical Laboratory entrance and toilet room, and for miscellaneous offices and toilets are each of the standard type oil-fired hot air furnace, equipped with blower, cleanable type air filter and gun type oil burner. Each unit is automatically controlled by a thermostat located in the space served, and by safety devices such as furnace-stat and stack switch. Air is distributed to the various rooms through a system of sheet metal ducts and diffusers. Provision is made for the introduction of fresh air in part. These units have capacities ranging from 65,000 to 170,000 Btu per hr.

Oil piping serving all oil-fired unit heaters is located in the trusses with drop branches to the various unit heaters. Sheet metal flues project through the roof of the building and discharge the exhaust gases to the outside through a capped outlet.

Steam Heat

The Chemical Laboratory is heated by direct cast iron radiators and is also provided with a fresh air supply from the roof of the building through a sheet metal fresh air duct. This air is tempered and delivered to the room by a disc fan unit heater. Radiators and unit heater are supplied with low pressure steam by an oil-fired steel heating boiler of 8,500 sq ft capacity located in the Oil Heating House. The oil burner is of the industrial rotary type, burning Grade No. 3 oil. Supply and return mains pass underground from the Oil House to the Chemical Laboratory through underground conduits.

This boiler also supplies steam through underground piping to an oil heater which heats the oil in the underground heavy-oil storage tank, and to the oil loading pits along the railroad siding. It also supplies steam through overhead mains to a horizontal oil storage tank located above ground.



Sketch showing typical arrangement of Dravo direct oil-fired heaters used in the new Foundry Building. Each of 78 such units is rated at 1½ million Btu per hr and 14,000 cfm.

The heavy oil is used to heat the open hearth furnaces.

Ventilation

Air is exhausted from toilet rooms and sub-stations either by power type ventilators, wall mounted disc fans, or by utility type blowers. A few toilet rooms are provided with gravity type ventilators only.

Filtered air is supplied to one of the substations by a unit consisting of multiblade type blowers and cleanable type air filters. No heater for this air is provided.

The Office Building is a separate two story structure with part basement. Besides offices, the building houses a cafeteria, a works locker room, washing and toilet facilities and a garage. This building has its own heating plant located in the basement. Two oil-fired, low pressure steam, steel heating boilers of 12,150 sq ft capacity each, and duplex vacuum pumps of 15,000 sq ft capacity each, comprise the heating plant.

The cafeteria which is located on the first floor front is heated by convectors located under the windows, and is supplied with fresh tempered air by a supply unit located in the basement.

This same ventilating unit also supplies air to the garage. Exhaust from the garage is accomplished through a vertical masonry flue with a ventilator at the roof.

The office portion of this building which is located on the second floor front is heated by convectors located under the windows. No ventilation is provided for the office portion.

The first floor locker, wash, and toilet room portion which occupies the rear of the building is heated and ventilated by a supply unit consisting of blower, tempering and heating coils and air filters. This unit is located in the basement adjacent to the boilers. Air is exhausted from the first floor locker room through vitrified tile conduit located under the locker room floor, by an exhaust fan located in the basement.

Air is supplied to the second floor locker room which is located directly above the locker room on the first floor by a unit located in a pent house on the roof, and is exhausted from the top of the lockers through sheet metal ducts located on the ceiling of the second floor by an exhaust fan located in the same pent house.

Air is exhausted from the smaller toilet and interior rooms by an exhaust fan located on the roof of the building.

The kitchen is heated by a disc fan unit heater located in the kitchen itself. Air is exhausted from the kitchen through hoods and ducts by a kitchen exhaust fan located on the roof. No air is supplied to the kitchen, but a flow of air from the adjoining cafeteria is induced by the exhaust fan.

From the foregoing description it will be evident that the heating and ventilating systems of this group of buildings are about as simple as could be devised for the service intended. The objectives of conserving materials and at the same time providing for adequate heat and ventilating for foundry requirements appear to have been attained in this design.

Contractors for the heating and ventilating work for the factory portion were Sears and Piou; for the office building, Elliott & Barry on piping, and Acme Heating & Ventilating Company on sheet metal work. All of these firms have headquarters in St. Louis, Missouri.

How to Design Exhaust Hoods

By J. M. DALLA VALLE

Engineer and Consultant,
Kruse Engineering Co.,
Newark, N. J.

Part 4—Criteria for Determining Hood Effectiveness

AIR exhaust methods for occupational disease prevention vary widely. In controlling its hazards each plant generally applies methods best fitted to its particular layout. Economic and mechanical factors are also important considerations which result in a diversity of type and construction of preventive equipment. Thus, with few exceptions, information regarding the performance of various equipment is confusing and renders comprehensive treatment of preventive methods difficult. At the same time it must be stressed that extensive performance data are lacking. This lack may be attributable in part to the reasons given above, but chiefly to the fact that methods of testing control equipment, based on determinations of the concentration of air-borne contaminants, have been used frequently. In addition, insufficient air flows have been provided, and the limitations of suction data have not often been appreciated. This part outlines the basic principles of test criteria, both by threshold limits and the provision of air volume requirements.

Value of Threshold Limits

Local exhaust ventilation is used primarily to reduce the concentration of air contaminants to safe and hygienic limits. A knowledge of the velocity characteristics of hoods does not immediately determine whether the air volumes chosen will be effective in removing the contaminant. In other words, although the installation and use of a correctly designed hood is essential in maintaining a safe environment, it is not in itself a solution of the problem. To determine the effectiveness of a given hood, it is necessary to evaluate the concentration of the substance being collected which remains in the air and is constantly breathed by the worker. The amount present must be kept below the limit considered safe for continuous exposure.[4]

The application of quantitative methods in determining the effectiveness of exhaust hoods is experimental. The air requirements necessary to control dust in granite cutting cannot be stated *a priori.* Only by varying the air flows through a hood and by making dust counts is it possible to establish the quantity of air which will reduce the dust generated to a safe limit (estimated at 10 million particles per cubic foot). The effect of increasing the amount of ventilation to reduce the dust produced by granite cutting tools is shown in Fig. 35.[5] It may be seen from the curve that for the particular type of hood shown, air volumes exceeding 300 cfm are required in order to reduce the dust concentration to values below 10 million particles per cubic foot. Similar examples are presented later.

The extension of the foregoing technic to other conditions is simple. Thus, for controlling chromic

[4]U. S. Public Health Service, 1935. The determination and control of industrial dust, J. J. Bloomfield and J. M. Dalla Valle, Bulletin 217.

[5]Hatch, Theodore; Drinker, Philip, and Choate, Sarah P., 1930. Control of the silicosis hazard in the hard rock industries. I. A laboratory study of the design of dust control systems for use with pneumatic granite cutting tools. Jour. Industrial Hygiene & Toxicology, 12:75-91.

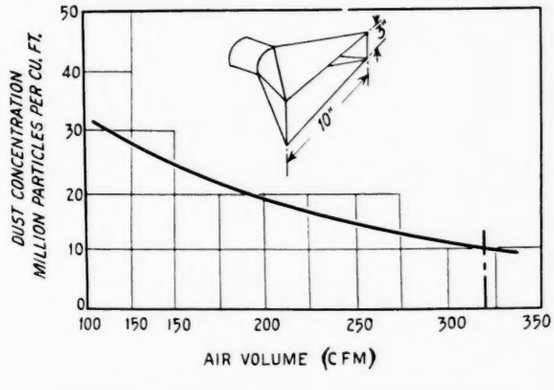


Fig. 35

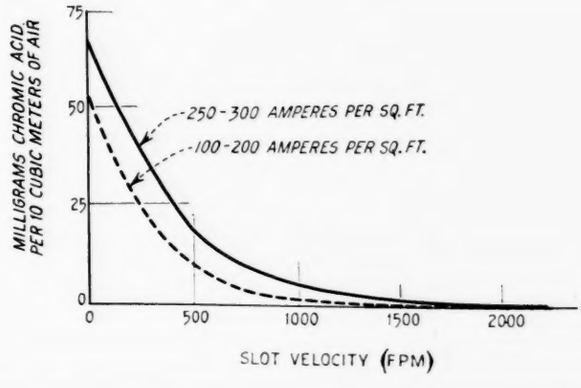


Fig. 36

acid mists (for which the safe limit is 1 mg per ten cubic meters of air) opening velocities of 1500 fpm are required for current densities ranging from 250-300 amperes per sq ft, and over 1000 fpm for densities ranging from 100-200 amperes per sq ft.[6] The ventilation conditions are shown in Fig. 36.

Every hood must exhaust sufficient air to eliminate a given nuisance or hazard to health. The amount of air handled must be large enough so that under all conditions the contaminant remaining in the air is less than that determined as the safe or threshold limit.

Wherever hoods are installed to eliminate a health hazard, tests should be conducted to establish their effectiveness. The ultimate criterion of hood performance is not the provision of a "strong" suction, but the handling of an air volume which reduces the concentration of the contaminant in question below the threshold limit. At the same time, recognition of the factors entering into the design of the hood may materially reduce the air volume necessary to produce a safe environment. Hoods are of no value in the prevention of occupational disease unless they eliminate the hazard. The characteristics given earlier indicate basic principles which may save on power costs for generating the air volumes handled. While the cost of installation is still the predominant factor to industry, operating costs will gradually become more and more important.

Threshold Limits

Table 6 gives the safe limits of exposure to certain dusts, while Table 7 gives the safe limits for a large group of gases, vapors, and mists. The limits for the various dusts listed are based upon correlations between impinger counts* and physical findings noted in large groups of exposed workers; while the data of Table 7, with few exceptions, are based on animal experiments. For this and other reasons, care should be exercised in assuming that the limits given in the table are safe to workers. Threshold limits act as guides or benchmarks in determining whether the hood is functioning effectively. In any case, the air volumes handled by hoods should always be *more than sufficient* to produce a hygienic atmosphere.

Rate of Air Flow Required

The rate of air flow through the hood, necessary to produce the required air velocity at any given point, depends upon the size, shape, and location of the hood, as well as the manner in which the contaminant is produced. It follows, therefore, that some knowledge of the aerodynamic characteristics of suction openings is necessary to the proper choice of hoods if economic design is to be attained. These data, plus the known safe limits of exposure discussed above are of importance to the designer.

The rapidly decreasing centerline velocity curves presented in Fig. 19 show the need for locating the hood as closely as possible to the point of dust generation. This is a general rule, and is applicable to all conditions. It should be noted that the rate of decrease in velocity with distance from the hood decreases with an increase in area of the opening. Moreover, the contour lines become more flattened, as indicated in Fig. 18. These facts point to the desirability of using as large an opening as possible, which has the further advantage of reducing the power consumption by lowering the entrance pressure loss.

[6]Bloomfield, J. J., and Blum, W., 1928. Health hazards in chromium plating. Public Health Reports, 43:2330-2347.

*Public Health Service Impinger Technic (see Public Health Bulletin No. 217).

TABLE 6.—PROBABLE SAFE LIMITS OF EXPOSURE FOR CERTAIN INDUSTRIAL DUSTS AS DETERMINED BY VARIOUS INVESTIGATORS

	Per Cent Free Silica	Safe Limit (Million Particles per Cubic Foot), Impinger Apparatus	References
Granite (Barre)	35	10-20	Russell, A. E., Britten, R. H., Thompson, L. R., and Bloomfield, J. J.: The Health of Workers in Dusty Trades. II. Exposure to Siliceous Dust (granite industry). Public Health Bulletin No. 187, 1929.
Anthracite coal	3	50	Bloomfield, J. J., Dalla Valle, J. M., Jones, R. R., Dreessen, Waldemar C., Brundage, Dean K., and Britten, Rollo H.: Anthraco-Silicosis Among Hard Coal Miners. Public Health Bulletin No. 221, 1935.
Haulageway (anthracite mines)	13	10-15	
Rock workers (anthracite mines)	35	5-10	
Asbestos (textile)	—	5	Dreessen, W. C., Dalla Valle, J. M., Edwards, T. I., Miller, J. W., and Sayers, R. R.: A Study of Asbestosis in the Asbestos Textile Industry. Public Health Bulletin No. 241, 1938.
Silverware (manufacturing)	—	12[1]	Goddard, Jennie C.: The Health of Workers in Dusty Trades. V. Exposure to the Dusts of a Silverware Manufacturing Plant. Public Health Bulletin No. 208, 1933.
Lead (storage battery)	—	0.15[2]	Russell, A. F., Jones, R. R., Bloomfield, J. J., Britten, R. H., and Thompson, L. R.: Lead Poisoning in a Storage Battery Plant. Public Health Bulletin No. 205, 1933.
Iron oxide (welding)	—	10[2,3]	Drinker, Philip, Warren, Henry, and Page, Richard: Electric Welding. III. Prevention of the Respiratory Hazard. Jour. Ind. Hyg. 17, No. 4, 1935.

[1]Only 9 of 257 samples collected were greater than this amount. [2]Milligrams per cubic meter. [3]Not based upon clinical findings.

TABLE 7.—PHYSICAL PROPERTIES OF COMMON GASES AND VAPORS BASED ON CURRENT LITERATURE[1,2]

	Substance	Formula	Specific Gravity (Air = 1)	Boiling Point (Deg. C.)	Vapor Pressure (Mm Hg 20° C.)	Lower Limit of Inflammability (% by Volume)	Probable Safe Limits of Exposure to Man and Animals (ppm)	
1.	Acetone	$CH_3 \cdot CO \cdot CH_3$	2.0	56.5	184.8	2.2	1265-2110 (cats)	1
2.	Ammonia	NH_3	0.6	— 33.4	Gas	16	85-100 (man)	2
3.	Amyl acetate (n)	$CH_3 \cdot COO \cdot C_5H_{11}$	4.5	142	N. D.	1.1	<400 (man)	3
4.	Amyl acetate (s)	$((CH_3CH_2CH_2)CH_3 \cdot CHO \cdot COCH_3)$	4.5	133	N. D.	N. D.	<0.2[4] (guinea pigs)	4
5.	Aniline	$C_6H_5 \cdot NH_2$	3.3	184.4	2.4	N. D.	<7 (man)	5
6.	Benzene	C_6H_6	2.7	80.4	34	1.4	100 (man)	6
7.	Bromine	Br_2	4.7	58.8	Gas	N. I.[5]	0.15-0.3 (man)	7
8.	Butyl acetate (n)	$CH_3 \cdot COO \cdot C_4H_9$	4.0	125	11	1.7	<400 (man)	3
9.	Carbon dioxide	CO_2	1.5	— 78.5	Gas	N. I.	5550 (man)	9
10.	Carbon disulphide	CS_2	2.6	+ 46.3	Gas	4.3	<20 (man)	10
11.	Carbon monoxide	CO	0.97	— 190	Gas	12.5	<100 (man)	11
12.	Carbon tetrachloride	CCl_4	5.3	76	90	N. I.	<100 (man)	12
13.	Cellosolve (monoethyl ether of ethylene glycol)	$CH_2OH \cdot CH_2OC_2H_5$	3.1	134.8	4.6	N. D.	0.05[4] (guinea pigs)	13
14.	Chlorine	Cl_2	2.5	— 34.6	Gas	N. I.	<0.35 (man)	14
15.	Dichlorethylene (trans)	$CHCl:CHCl$	3.0	59.8	260	N. I.	<3 (man)	15
16.	Dichloroethyl ether	$(ClCH_2CH_2)_2O$	4.9	178.6	0.73	N. D.	<15 (guinea pigs)	16
17.	Diethylene dioxide	$O(CH_2)_4O$	3.0	101.1	28.0	N. D.	1[4] (guinea pigs)	17
18.	Ethanol	C_2H_5OH	1.6	78.4	43.9	3.5	<1000 (man)	18
19.	Ethyl benzene	$C_6H_5C_2H_5$	3.6	136.5	15.3	N. D.	<0.1[4] (guinea pigs)	19
20.	Ethyl chloride	C_2H_5Cl	2.2	12.2	1100	4	<1[4] (guinea pigs)	20
21.	Ethylene dichloride	$C_2H_4Cl_2$	3.4	83.5	78	6.0	<100 (guinea pigs)	21
22.	Ethylene oxide	CH_2CH_2O	1.5	13.5	1100	3	0.025[4] (guinea pigs)	22
23.	Formaldehyde	$H \cdot CHO$	1.0	— 21	Gas	N. I.	<20 (man)	23
24.	Gasoline	$CnH_{2n}+_2$	1.7-5.0	50-144	...	1.4	10[6] (man)	24
25.	Hydrogen chloride	HCl	1.3	— 83.7	Gas	N. I.	<10 (man)	25
26.	Hydrogen cyanide	HCN	0.93	25.2	N. D.	N. D.	<18 (man)	26
27.	Hydrogen fluoride	HF	0.7	19.4	N. D.	N. I.	3 (man)	27
28.	Hydrogen sulphide	HS_2	1.2	— 59.6	Gas	4.3	<20 (man)	28
29.	Mercury	Hg	7.0	357.0	...	N. I.	1.0[7] (man)	29
30.	Methanol	CH_3OH	1.1	66	95	7.5	100 (man)	30
31.	Methyl bromide	CH_3Br	3.3	4.5	Gas	N. D.	0.010[4] (guinea pigs)	31
32.	Methyl butyl ketone (iso)	$CH_3 \cdot CO \cdot C_4H_9$	3.5	107	13.0	N. D.	0.15[4] (guinea pigs)	32
33.	Methyl chloride	CH_3Cl	1.8	— 24	Gas	4	<0.12[4] (guinea pigs)	33
34.	Methyl ethyl ketone	$CH_3CH_2COCH_3$	2.5	79.6	N. D.	N. D.	0.3[4] (guinea pigs)	34
35.	Methyl formate	$HCOOCH_3$	2.2	31.8	476.4	4.5	0.15[4] (guinea pigs)	35
36.	Methyl propyl ketone	$CH_3 \cdot CO \cdot CH_2 \cdot C_2H_5$	3.0	101.7	N. D.	N. D.	0.15[4] (guinea pigs)	36
37.	Nitro benzene	$C_6H_5 \cdot NO_2$	4.2	210	N. D.	N. D.	60 (man)	37
38.	Nitrogen tetraoxide	NO_2 or N_2O_4	1.6-3.2	— 21.3	Gas	N. I.	10 (as NO_2) (man)	38
39.	Ozone	O_3	1.6	— 112	Gas	N. D.	1.0 (man)	39
40.	Phosgene	$COCl_2$	3.4	8.2	Gas	N. I.	<1 (man)	40
41.	Sulphur dioxide	SO_2	2.3	— 10	Gas	N. I.	10 (man)	41
42.	Toluene	$C_6H_5 \cdot CH_3$	3.2	111	N. D.	1.4	100 (man)	42
43.	Tetrachlorethylene	$CCl_2:CCl_2$	5.7	120.8	N. D.	N. I.	<100[8]	43
44.	Trichlorethylene	$CHCl:CCl_2$	4.5	87.2	57	N. I.	<100[8]	44
45.	Turpentine	$C_{10}H_{16}$	4.7	146	N. D.	N. D.	<200 (man)	45
46.	Vinyl chloride	CH_2CHCl	2.2	— 13.9	N. D.	4	0.5[4] (guinea pigs)	46
47.	Xylene (m)	$C_6H_4(CH_3)_2$	3.7	136-141	N. D.	N. D.	100 (man)	47

[1]In addition to the substances listed in this table may be mentioned chronic acid with a probable safe limit of exposure of 1 milligram per 10 cubic meters, and the chlorinated naphthalenes, less than 10 milligrams per cubic meter being safe for the trichlornaphthalene and 0.5 milligrams for naphthalenes of higher chlorination.

[2]Data are based chiefly on the following sources: (a) "Schædliche Gase," Ferdinand Flury and Franz Zernik. Berlin, 1931; (b) Publications of the Bureau of Mines and the Public Health Service; and (c) International Critical Tables, published by McGraw-Hill Book Company, Inc., New York; (d) "Noxious Gases," by Y. Henderson and H. W. Haggard, Amer. Chem. Soc. Monograph No. 35, The Chem. Cat. Co., Inc., N. Y., 1927; (e) and Standards of the American Standards Association, 29 West 39th St., New York, N. Y.

[3]No data. [4]Per cent by volume. [5]Noninflammable. [6]Milligrams per liter. [7]Milligrams per 10 cubic meters. [8]Assumed to be as toxic as carbon tetrachloride.

TABLE 8.—MINIMUM AIR VELOCITIES REQUIRED TO CAPTURE CERTAIN INDUSTRIAL DUSTS AND VAPORS

Industry	Process	Required Air Velocity		Criterion
		At Point of Origin	At Face of Hood	
Granite cutting	Hand pneumatic tool	200 fpm		Reduced concentration to safe level
	Surfacing machine	1500 fpm		Reduced concentration to safe level
	All tools		1500 fpm	Reduced concentration to safe level
Grain elevators	Elevator boot and head, garner		500 fpm	Visual test
Paint spraying	Spraying booth		50-200 fpm	Reduced concentration to safe level
Sand pulverizing	Bagging machine	400 fpm		Reduced concentration to safe level
Electroplating	Chromium plating	50**	1500 fpm	Reduced concentration to safe level
	Steam and acid tanks	75-100		Reduced concentration to safe level
Hatters' fur	Brushing	200*		Usual practice
	Cutting machines	380*		Usual practice
	Blowers	2000*		Usual practice
Electric welding	Welding	200		Visual test
Metal spraying***	Lead Zinc	200 125		Effective removal of all fumes

*Cubic feet per minute. **Cubic feet per minute per foot of slot (common practice). ***At opening of booth.

The area over which the contaminant is produced must also be considered in choosing the size of the hood opening. Thus, for a concentrated point of dust generation a flat velocity contour is not as necessary as for more extensive areas of dust generation. In all cases, the object is to obtain a uniform air velocity over the region of dust production, and the lowest possible flow from areas of no dustiness—the so-called ineffective areas. In other words, the ratio of effective to ineffective flow should be made as high as possible. Since the flow distribution in the zone of influence of suction openings is intimately associated with the size and shape of the opening, great care must be exercised in choosing a hood to give a high ratio of distribution in effective areas. In this connection, the use of flanged openings is often advantageous. Flanged exhaust hoods on hand pneumatic granite carving tools, in place of unflanged openings, demonstrates the saving in power consumption possible. For this process an air velocity of 200 fpm at the tool is required. Operating conditions demand that the hood be at least five in. from the tool. At this distance, the required air velocity is obtained by a flow of 300 cfm through a rectangular opening 3 by 6 in. in dimension. The addition of a 3-in. flange around the opening reduces the rate of air flow to 200 cfm, a saving of 33-1/3%. Since the pressure loss at entrance is also reduced, the power consumption is lowered by more than a third. Wherever conditions permit their use, the installation of flanges is recommended.

Table 8 gives the velocities required at points producing certain air contaminants.[7,8] In each instance, consideration must be given to the area over which the contaminant is produced, and the velocity characteristics of the hood chosen. These are to be discussed later.

Static Suction as a Measure of Hood Effectiveness

So far, every effort has been made to avoid the term "suction at the hood." Static suction, without reference to duct diameter at the point of measure-

[7]Air Hygiene Foundation of America, Inc., 1938. Design of exhaust hoods. Preventative Engineering Series, Bulletin 2, Part 4.
[8]Drinker, Philip, and Hatch, Theodore, 1936. Industrial dust. McGraw-Hill Book Co., New York. 1st ed.

TABLE 9.—CUBIC FEET OF AIR HANDLED PER MINUTE THROUGH AVERAGE GRINDING WHEEL HOODS
(Based on restriction coefficient of 0.71)

Diameter of Connecting Duct, Inches	Suction at Throat, Inches Water Gage						
	1	1½	2	2½	3	4	5
2	62	76	88	98	107	124	139
2½	97	119	146	153	168	195	216
3	139	171	197	221	242	278	312
3½	190	232	269	300	329	380	424
4	248	304	351	392	430	497	554
4½	314	384	444	496	542	627	705
5	388	475	550	615	675	775	878
6	558	683	789	881	968	1117	1250

ment, is meaningless. As a measure of air volume its value is also doubtful. Static suction measurements do not indicate *flow,* since such measurements can be obtained in a completely closed system in which no air flow whatever can take place. Thus, a hood may contain an obstruction, and yet suction can be measured provided the fan is in operation. The "suction" of an obstructed hood is higher than one which is not, since without flow the entrance losses are nil.

In theory, with an unobstructed duct system of known diameter, static suction is a measure of air flow. The air flow is given by the equation:

$$Q = 4009\ A\ f\ \sqrt{h_s} \quad \text{.....27}$$

where Q = air flow in cubic feet per minute,
A = area of duct at point of measurement, in sq ft,
f = a factor, usually ranging from 0.6-0.9, and
h_s = static suction in inches H_2O.

In practice, reference is rarely made to the duct diameter. The value of rating hoods directly in terms of the air volumes handled lies in the fact that it at once gives an approximate estimate of hood size.

Table 9 shows the amount of air handled by hoods with connections of various sizes. The effect of suction is clearly indicated. Thus, a duct connection 3 in. in diameter with 2-in. static suction, handles only 0.63 the amount of air supplied with 5-in. suction. In other words, the volume is proportional to the ratio of the square roots of the static suction ($\sqrt{2/5} = 0.63$). At the same time, the increased static suction implies a higher velocity and a subsequently greater resistance in the duct connection. With 2-in. suction on a 3-in. diameter connection, the air velocity is 4,012 fpm, while with 5-in. suction it is 6,354 fpm; if the resistance is assumed to vary as the square of the velocity, the resistance in the case of the higher velocity is approximately 2½ times that at the lower. Obviously, good design would call for a larger duct connection in the latter instance in order to offset the increased losses. On the other hand, since a 5-in. suction must be maintained in accordance with some state codes, the volume is increased with a larger duct connection and any gain thus obtained is nullified. For example, a suction of 5 in. in a 3-in. diameter duct connection is equivalent to 197 cfm; in a 4-in. diameter duct, the volume of flow would be equivalent to a suction of 2½ in. It is clear that the ventilation performance of hoods (at least for the purpose of efficient design) should be based on the air volumes handled and not upon a rigid suction standard. Of course, the volumes most effective for controlling the dust generated should be established by experiment.

(Next month's installment will discuss hoods for dust control.)

Forced Ventilation Improves Hay-Making Methods

Man-made devices and methods aren't always able to improve upon those of Nature, but in the age-old problem of the curing or drying of hay, Mother Nature appears about ready to be relegated to second place. This is shown as a result of experiments reported recently by R. C. Miller and G. R. Shier in a paper presented at a meeting of the American Society of Agricultural Engineers, in Chicago. The studies were conducted in Ohio, extending over a period of four years.

The methods used for centuries of "making hay while the sun shines"—cutting, field drying in the sun, and moving into storage as soon as possible—have always been subject to the vagaries of the weather and to the physical ability of farmers to do the job in an allotted, but unforeseeable amount of time. As a result, certain important losses have practically always occurred, and were so commonplace as to be accepted almost as part of the process. A fair estimate, it is said, is that on the average, one-half the first cutting of alfalfa hay is lost as feed. One important loss comes from the shattering of leaves, which occurs both before and after the plant is cut. The leaves carry 60 to 75% of the total protein in hay. Hay stored in the mow must have a moisture content of not over 20% if excessive heating and mold damage, or actual spontaneous combustion and fire loss in storage are to be avoided.

When field drying reduces the moisture content to 30% or under, the dry leaves shatter easily in the handling processes, which include feeding, raking, loading, stacking, and storing in the mow. Another important loss is represented in a decrease in vitamin content due to excess weathering in the sun.

In the Ohio experiments the hayloft was fitted with a plenum or air tunnel running along one side, fed by a 48 in. propeller fan of 25,000 cfm capacity, handling 100% outside air. A system of lateral floor ducts spaced on about 6 ft centers was connected into the plenum. The fresh air discharged from these ducts passed uniformly up through the mass of hay which was piled high on the ducts.

The chief advantage of this system is that hay can be brought in under cover as soon as convenient after cutting without having to depend upon the weather to bring the moisture content down to a safe storage point. Hay varying from 25 to 55% in moisture content is piled to heights 8 to 20 ft in the mow, and forced circulation used for periods of ten to thirty days until the desired degree of dryness is obtained. Since the handling is all done promptly while the hay is fairly green, the losses mentioned are virtually eliminated.

WASHINGTON NEWS

Summarized by Loring F. Overman. Petroleum Shortage Woes Increase; 38,000 Hp. of Used A.C. Transferred; Steel Pipe Fittings Are Simplified.

An ominous note, new at least to the public, crept into the Washington scene during the flood-inspired May squeeze that curtailed oil and gasoline shipments, drove thousands of automobiles off the highways, and caused the "no gas" sign to hang on countless service stations.

While transportation difficulties were directly responsible for the drastic curtailment of motor fuels, the difficulties forced into the open a latent suspicion that petroleum production is also having its troubles.

Since the petroleum shoe first began to pinch, the public has been told to blame delivery—the tanker sinkings, discontinuance of tanker routes, assignment of tankers to military service, and so on. Production has been given a clean bill of health in all the publicity, the inference being that the country's petroleum resources were utterly inexhaustible.

Dissenting voices were soft-pedalled. It is only recently that official heads nod limited affirmation when the possibility of a production shortage is suggested. Indications are that the subject has been discussed behind the scenes. Apparently, however, it has proved difficult to stir up sufficient interest in the subject to budge all of the varied governmental units involved.

War Council View

As early as February 3 of this year, the Petroleum Industry War Council, established by Petroleum Administrator for War Harold Ickes to work with the government in solving war problems, issued the following report:

"It is the considered judgment of the petroleum industry that the United States faces a very serious shortage of petroleum available for wartime use within the near future.

"These conclusions have been reached after long and careful consideration by members of this industry. Petroleum is now being used from present reserves at a rate far in excess of the rate of discovery of new reserves from which to produce future requirements.

"The rate at which petroleum is being produced now cannot be greatly increased without serious loss to the reserves on which the future supply depends.

"Exact estimates of future needs cannot be obtained, but every obtainable estimate indicates marked increases of these demands."

Ickes Testifies

Testifying before the Truman committee last month, Secretary Ickes said that PAW had estimated 1944 requirements for high-octane gasoline at six times the 1941 capacity, which he placed at 40,000 barrels per day. Judging by the increase in plane production since 1941, Washington estimators place present requirements of 100-octane at more than 100,000 barrels per day—a total said to be far in excess of production.

If Secretary Ickes' figures for 1944 are correct (and it must be admitted his guesses on the oil situation have often been closer to the mark than his critics like to admit), it would appear that 1,000,000 barrels of oil daily will be needed in 1944 to provide for aviation needs. (It takes four barrels of crude to manufacture one barrel of 100-octane.)

Frederick Smith, (left) chief, Special Equipment Branch, GIE Division of WPB, talks things over with Roderick Tate, deputy chief of the Air Conditioning and Refrigeration section.

National oil production today is approximately 4,000,000 barrels per day. Thus, if it becomes necessary to assign one-fourth to aviation and to share the remaining 3,000,000 barrels with the fleet, the armies of the world, and with lend-lease nations, it becomes apparent that the civilian's share may be considerably smaller than at present unless new production is enlisted.

PAW Urges Drilling

Just as PAW Administrator Ickes battled WPB for the steel for his big-inch pipeline, he is now battling OPA for price concessions that will encourage private industry to drill hundreds of new oil wells. The industry is said to be behind him in his drive, and indications are that if he is not successful soon, one of the first tasks of War Mobilization Chief James F. Byrnes will be to straighten the tangled threads.

PAW-OPA Agreement

In the meantime, OPA and PAW are in agreement on one thing—that nothing must be left undone to pare down present consumption of petroleum. Bans on pleasure motoring, and on any allowances of petroleum for pleasure boating are apparently to be in effect for the summer.

As for winter, both OPA and PAW agree on a conversion program that seeks to double last year's fuel oil saving of 60,000,000 barrels. This they hope to accomplish by relaxing slightly the pressure on individual homes, while at the same time putting the conversion screws on 10,000 barrels per season users except in specified areas.

1943-44 Conversion Policy

The following conversion program has been announced by the Conversion Policy Committee, which is composed of representatives of the War Production Board, Office of Civilian Supply, Petroleum Administration for War, Solid Fuels Coordinator, Office of Defense Transportation and the Office of Price Administration:

1. Continue the present policy of not requiring mandatory conversion of private dwellings.

2. Discontinue the present policy of denying auxiliary rations to convertible private dwellings.

3. Discontinue at once all government promotion by OWI, OPA, PAW, etc., urging the conversion of private dwellings to coal, with this decision to be reviewed on July 1 and September 1.

4. Continue the present OPA policy of mandatory conversions of heating equipment in buildings other than private dwellings, using oil for heating or hot water, but with the following exceptions:

(a) No mandatory conversions of this type shall be made in Florida, Georgia, Washington, Oregon and Idaho.

(b) No mandatory conversions of this type shall be made for installations using less than 10,000 gal in the 1942-43 heating year in New England, North Dakota, South Dakota, Nebraska, Kansas and Missouri.

5. Continue present PAW policy of virtual mandatory conversion of industry users of oil for power and processing, but with the following exceptions:

(a) No mandatory conversions of this type shall be made in Florida, Georgia, Washington, Oregon and Idaho.

(b) No mandatory conversions of this type shall be made of installations using less than 10,000 gallons in the 1942-43 heating year in New England, North Dakota, South Dakota, Nebraska, Kansas and Missouri.

6. Continue present OPA policy of not requiring conversion of kerosene range burners.

Convertibility Defined

OPA's Fuel Rationing Division, through Amendment No. 64 to Rationing Order No. 11, provides the following revised definition of convertible facilities:

"Convertible facilities means *any fuel oil burning equipment in premises other than private dwellings*, which may be altered or refitted to use an alternate fuel. However, the equipment is not convertible if one or more of the following conditions exist:

(a) An adequate supply of an alternate fuel is not available; or

(b) The materials or labor needed to alter or refit the equipment to use an alternate fuel are not available; or

(c) The materials or labor needed may be obtained only with unreasonable expense; or

(d) The equipment furnishes heat or hot water, or both, to premises located in the States of Maine, Vermont, New Hampshire, Massachusetts, Connecticut, Rhode Island, North Dakota, South Dakota, Nebraska, Kansas, or Missouri, and the allowable ration for the entire heating year is less than 10,000 gallons; or

(e) The equipment furnishes heat or hot water, or both, to premises located in the States of Florida, Georgia, Idaho, Oregon or Washington.

"No ration shall be issued or used for the operation of convertible facilities for furnishing heat or hot water, or both, except to the extent necessary to operate these facilities until the earliest date when conversion can be completed."

By this amendment, auxiliary and supplemental rations will no longer be denied to private dwellings because of "convertibility."

Engineering Task

A possible new assignment for heating engineers is suggested in an announcement made May 14 by the Bureau of Mines, that colloidal fuel, a mixture of pulverized coal and oil, was used successfully during a one-month test in a boiler plant of the Atlantic Refining Co., at Philadelphia, Pa. The report emphasizes the necessity for the employment of careful study and sound engineering practice.

In the tests, a mixture of 40% pulverized bituminous coal, most of which was ground as fine as talcum powder, and 60% No. 6 (Bunker C) fuel oil, was fed to a furnace using a steam atomizing type of burner. The test was run as part of the regular plant routine with existing equipment which was operated with the Bureau in the tests.

While colloidal fuel probably cannot be burned in domestic heating furnaces, its adoption by industry could alleviate shortages among other industrial consumers, the Bureau points out. Likewise, wide use of the colloidal fuel would open a new field for bituminous coal.

If colloidal fuel came into general use, it could be prepared in central mixing plants and delivered to consumers as fuel oil now is delivered. The substitution of a mixture of coal and oil for oil-burning furnaces of the East Coast would be particularly important because less oil would have to be transported to meet needs of the region, the Bureau commented.

A-C Used Equipment

More than fifty firms in some of the nation's leading cities have responded to the Government's appeal for heavy air-conditioning units needed for the control of temperatures in essential war plants. Already, twenty-two such units, representing a total capacity of about 38,000 hp, have been moved to plants producing high octane gasoline, synthetic rubber and airplane engines, the War Production Board reported May 25.

The units were offered by department stores, office buildings and hotels. The contributors whose units have already been moved are Macy's, Gimbels, Tiffany & Co., Lord & Taylor, Metropolitan Life Insurance Co., and James McCreery, all of New York City; Mandel Brothers, International Harvester Co., and Goldblatt Brothers, of Chicago; J. L. Hudson Co., and Ford River Rouge Plant, both of Detroit; G. Fox & Company of Hartford, Connecticut; Sears Roebuck & Company of Washington, D. C.; Famous-Barr of St. Louis; Municipal Auditorium of New Orleans; Hutzler Brothers, Baltimore; Penn Mutual Life Insurance Co., of Philadelphia; Richard's Store, of Miami, and Burroughs Welcome & Co., Tuckahoe, New York. Some gave more than one unit.

One large airplane plant requiring about 9,000 tons of refrigerating capacity will go into operation July 1 with 68% of volunteered air-conditioning equipment and 32% new equipment. Units made by five different manufacturing companies are included in the installation.

F. B. Millham (left) staff assistant, and Sterling Smith, chief, Air-Conditioning section, Special Equipment Branch, General Industrial Equipment Division of the War Production Board.

A-C Ratings Lowered

Purchase orders for maintenance and repair parts for industrial and commercial refrigerating and air conditioning equipment must bear preference ratings of AA-5 or higher according to Limitation Order L-38 as amended May 28 by the War Production Board.

New P and H Deputy

James E. Auten, director of the Construction and Utilities Bureau, has announced the appointment of William C. Macdonald as deputy director of the Plumbing and Heating Division.

Mr. Macdonald was graduated from Harvard University in 1927 and became associated with the American Radiator and Standard Sanitary Manufacturing Corporation in the New England area. In 1933, he became general sales manager of the Maryland Sanitary Manufacturing Corporation of Baltimore. He entered Government Service in October, 1941, with the Housing Branch of the Construction Division.

Metals Saved

Further savings in such critical materials as copper, copper base alloy and zinc used in the manufacture of plumbing fixture fittings and trim were ordered by the War Production Board through issuance of Schedule V, as amended, of Limitation Order L-42. The amended schedule is a consolidation of the original Schedule V and Schedule V-a. A saving of more than 600,000 lb of copper a quarter is expected. The bulk of these savings will be made in the manufacture of flushometer valves, automatic high tank supply valves, wash fountain trim and ball cocks.

Other than for coating, no zinc is to be used except for the manufacture of specified items, which include clean-out plugs, escutcheon holders, flush tank trip lever assemblies and escutcheons.

A general exception from the restrictions of the schedule is made for products manufactured for laboratories, food packing establishments, hospitals, aircraft and ships where conditions require the use of the restricted materials. The schedule becomes effective July 5, 1943. This period of grace will permit manufacturers to complete work now in progress.

Pipe Fittings Simplified

The number of types of steel pipe fittings is reduced from 38,784 to 3,615 by Limitation Order L-278 issued by the War Production Board, to be administered by the Shipbuilding Division. Iron and brass pipe fittings were previously simplified by L-288, so that the new order rounds out the overall program simplifying pipe fittings production.

The types permitted comprise about 98% of all produced. In effect, therefore, the order eliminates many special jobs which interrupt the straight line production methods basic to the industry. Resultant increased production is expected to reduce backlog by about 10%.

It is estimated that the simplification will save about 3,500 tons of alloy steel, 175 tons of chromium and 17.5 tons of molybdenum.

Changes in specifications of materials and of pressure classes correspond closely with those of Order L-252 covering valves and valve parts. The chief reductions are in the number of sizes permitted for reducing fittings, used to join pipes of different diameters.

MAY WASHINGTON NEWS HIGHLIGHTS

EDITOR'S NOTE:—In addition to its monthly summary of Washington news, HEATING AND VENTILATING publishes a digest of the month's Orders, Amendments and other releases of particular interest to the industry. Complete copies of the releases can be secured by writing U. S. Information Center, 1400 Pennsylvania Ave., Washington, D. C., mentioning the date of the release and the reference number. The first figure in each listing is the date in May the release was issued:

29th—"GRATE AREA" RE-DEFINED. To clear up possible doubts as to meaning of "grate area" in definition of Class A coal stokers, WPB today issued General Limitation Order L-75, as amended. WPB-3695.

28th—REFRIGERATION PREFERENCES SET. Purchase orders for maintenance and repair parts for industrial and commercial refrigerating and air conditioning equipment must bear preference ratings of AA-5 or higher according to Limitation Order L-38 as amended today by WPB. WPB-3700.

26th—COLLOIDAL FUEL USE URGED. Large-scale manufacture and use by industry of composite or colloidal fuel, made from a mix of coal and oil, was proposed today by Petroleum Administrator Ickes as practical oil conservation measure. OWI-1911.

24th—SUMMER COAL DELIVERY URGED. Bituminous coal dealers and consumers, both industrial and domestic, served by Great Lakes docks were urged today by Solid Fuels Administrator Ickes to accept delivery of next winter's coal this summer instead of letting it accumulate in huge piles on lake docks. OWI-1900.

20th—NEW COOLING MACHINERY RULE. Technical changes in limitation order controlling production and delivery of commercial and industrial refrigeration and air conditioning machinery were made today by WPB in amending Order L-38. WPB-3605.

29th—JUNE OIL OUTPUT SET. Petroleum Administrator Ickes today announced production rate of 4,218,900 barrels daily of all petroleum liquids certified to various oil-producing states for June, 1943. OWI-1880.

18th—NATURAL GAS CHIEF NAMED. Appointment of Paul R. Taylor, Upper Montclair, New Jersey, as Director of National Gas Division, was announced today by Director Krug, Office of War Utilities. WPB-3575.

18th—OIL RATIONING ZONES CHANGED. Important change will be made in thermal zones in next year's fuel oil rationing plan to permit closer adjustments or rations of fuel oil supply and to weather conditions, OPA announced today. OPA-2496.

14th—RULE ON BOILERS MODIFIED. Practice of manufacturers of cast iron boilers and radiators of charging for delivery from point of delivery to job site was restored today by OPA through Amendment 2 to MPR-272, effective May 19. OPA-T-859.

13th—VENTILATORS RULE CONFORMED. Provisions of Steel Conservation Order MO126 relating to luggage and shutter type ventilators were altered today by WPB to make them conform to L-orders recently issued covering those products. WPB-3515.

10th—REFRIGERATOR PRICES REDUCED. Ceiling prices for commercial refrigeration and commercial refrigeration apparatus were ordered reduced today by OPA by an amount equal to federal excise taxes which were repealed November 1, 1942, through Amendment 4 to Order A-1 under MPR-188 and Amendment 163 to SR-14, effective May 10. OPA-2464.

8th—IRON PIPE FITTINGS REDUCED. The number of types of steel pipe fittings is reduced from 38,784 to 3,615 by Limitation Order L-278 issued today by the War Production Board, to be administered by the Shipbuilding Division. WPB-3476.

7th—OIL DISCOVERY REWARDED. Regulations which in some instances would make possible Government reward of more than 100% for discovery and development of new sources of petroleum for war program have just been put into effect by General Land Office, it was announced today by Secretary of the Interior Ickes. OWI-1791.

5th—COAL DISTRIBUTION CONTROL. Solid Fuels Administrator Ickes today cleared way for emergency wartime coal distribution, if such action becomes necessary in order to protect war plants and essential civilian users from shortages of fuel, with issuance of Reg. 1 of Solid Fuels Administration, which provides that "Solid Fuels Administrator for War may from time to time issue specific directions requiring, forbidding, or otherwise providing for the delivery of solid fuels by or to any person or persons." OWI-1783.

4th—FLORIDA PIPELINE SPEEDING UP. Between 28,000 and 30,000 barrels of gasoline will be flowing through trans-Florida Pipeline by June, Petroleum Administrator Ickes predicted today. OWI-1771.

3rd—PETROLEUM STOCKS REGULATED. Petroleum Administrator Ickes today announced Amendment 2 to Petroleum Directive 59 which: (1) Provides a petroleum "kitty" to assure supplies of principal petroleum products contracted for by Federal Government in the East Coast area, and (2) Protects supplier who obtains Government orders by providing that suppliers for Government will be withdrawn from kitty and will not affect allotment given supplier for his regular business. OWI-1756.

NO. 6 OF A SERIES

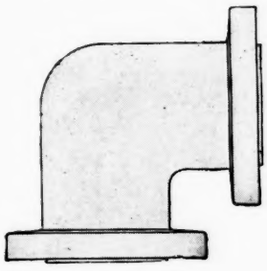
HOW TUBE-TURN WELDING FITTINGS BENEFIT WAR INDUSTRY

The FIRST WELDING FITTINGS 1ST AND STILL THE BEST

Weight saved* with Tube-Turn Welding Fittings aids war industry—by economizing steel, speeding pipe erection, conserving supports, reducing shipping weight.

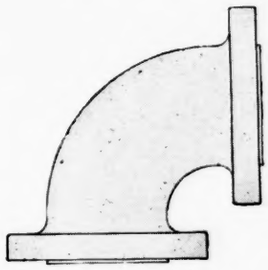
**Tube-Turn fittings in comparison below are 6", Schedule 80. Other fittings are 6", 600 lb. class.*

FORGED FLANGED ELBOW



450 lbs.

CAST STEEL FLANGED ELBOW

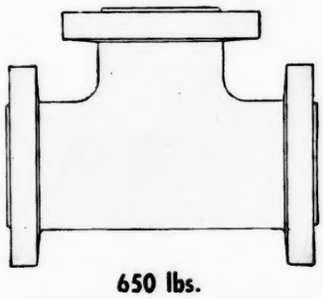


250 lbs.

TUBE-TURN WELDING ELBOW

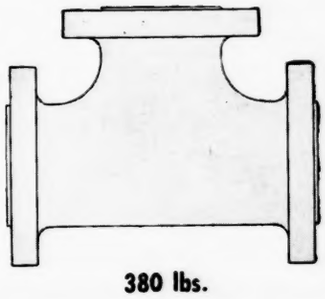
33½ lbs.

FORGED FLANGED TEE



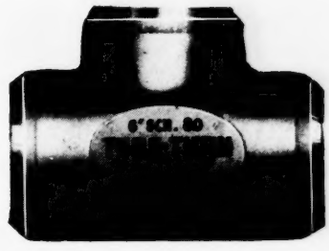
650 lbs.

CAST STEEL FLANGED TEE



380 lbs.

TUBE-TURN WELDING TEE



80 lbs.

THE examples illustrated above demonstrate the tremendous differences in weight between Tube-Turn welding fittings and other types of steel fittings. These comparisons are for 6" size (see note above), and other sizes are more or less proportionate.

Weight saving *always* has been an important reason for specifying Tube-Turn welding fittings. But today's war production needs stress additional advantages of this feature. It saves steel—because less of this strategic metal is required in making Tube-Turn fittings. Piping systems welded with Tube-Turn fittings are *lighter* and *streamlined*—which speeds erection, saves space, and simplifies structural problems. Remember these timely points when you buy or specify fittings for oil, gas, power, chemical, heating, air, refrigeration and marine piping today!

OTHER WAYS TUBE-TURN FITTINGS HELP WAR PRODUCTION:

SPEED INSTALLATION: Less time needed for aligning thanks to true circularity and uniform walls. Only simple butt welds required, easy even for novice welders. Whole section can be pre-assembled on the ground.

SAVES SPACE: Tube-Turn fittings permit streamlined, compact layouts and sharp angles—neater, more efficient piping.

REDUCES MAINTENANCE: No gaskets to replace, no nuts or bolts to tighten. Maintenance practically eliminated. Relieves men for other duties.

AVOID SHUT-DOWNS: Practically no danger of shut-downs due to connection failures as welding with Tube-Turn fittings *eliminates* the chances of leakage.

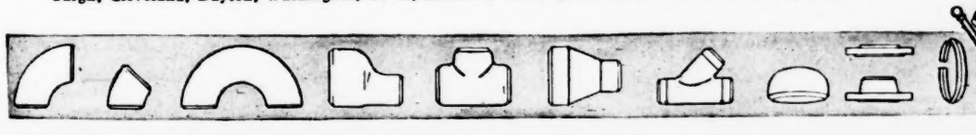
INCREASE SAFETY: Exclusive manufacturing process gives greatest possible strength in fittings, full freedom from leakage, and longer life in piping systems.

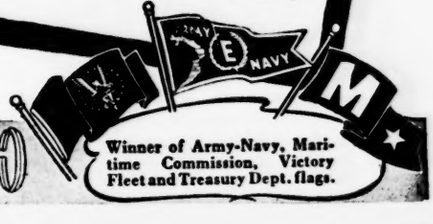
TUBE-TURN

TRADE MARK

Welding Fittings and Flanges

TUBE TURNS (INC.) LOUISVILLE, KY. ● *Branch offices:* New York, Chicago, Philadelphia, Pittsburgh, Cleveland, Dayton, Washington, D. C., Houston, Los Angeles. ● *Distributors in principal cities.*





Winner of Army-Navy, Maritime Commission, Victory Fleet and Treasury Dept. flags.

NEWS OF THE MONTH

Boston District Steam Expands

BOSTON—Edison steam service of this city recently has been deluged by applications for district steam service. These applications came not only from prospective users in the city limits, but from householders in Brookline, Dorchester, and even as far away as Waltham, fifteen miles out. Applicants were surprised to learn that the company's mains did not run everywhere. However, the State House, Boston City Hall and the huge Suffolk County Courthouse have been added to the lines, replacing two million gallons of fuel oil.

Activities of the company for the past year, including conversion of one or two of its own plants to coal, will save at least 6,500,000 gallons of heavy fuel oil next winter. Included among the new customers are two large telephone buildings, a church, the U. S. Coast Guard Receiving Station, a department store, several large office buildings, two restaurants and the Massachusetts Historical Society.

Boston Oil Men Elect Edwards

BOSTON—At the annual meeting of the Oil Heat Institute of New England held recently, the following officers were elected: president, Don J. Edwards; vice-president, Everett L. Wolife; executive secretary and treasurer, Fred N. Beckwith.

Guest speaker was Carroll E. Lewis, president of the Oil Heat Institute of America. Mr. Lewis announced that there would be regional meetings, about ten days apart of regional oil heat institutes, and a national meeting soon, at which plans would be formulated for a fight to secure more oil for the next heating season and better plans for handling its transportation and delivery. He declared that the statements that there would be no postwar oil for American consumers to be pure propaganda.

Corrosion Committee Elects Mears

PITTSBURGH—The American Coordinating Committee on Corrosion is again revising its confidential directory of technologists actively engaged in studies on corrosion and its prevention. The Committee comprises delegates from 15 major technical societies together with representatives from the principal industrial research institutes and the National Bureau of Standards. Its directory currently lists some 450 investigators, but there are undoubtedly some individuals who were not reached during the original circularization. Accordingly, the Committee requests that all persons actively engaged in corrosion researches who have not been contacted by the Committee, write to the secretary, Dr. G. H. Young, 4400 Fifth Avenue, Pittsburgh, for further details.

The fifth annual meeting of the Committee was held in April. Dr. R. B. Mears was elected Committee chairman for 1943-44. F. L. LaQue was named vice-chairman, and Dr. Young was re-elected secretary-treasurer.

New Warm Air Code for Los Angeles

LOS ANGELES—A proposed warm air heating code, representing ordinance revisions suggested by industry and public demand since the present setup was established in 1937, is in process of preparation by the Los Angeles Department of Building and Safety and embodies provisions pertaining to: Capacity of warm air furnaces and warm air heaters to meet certain minimum heating standards; construction and test requirements for warm air furnaces and warm air heaters conforming to specifications approved by American Standards Association; construction requirements for oil-burning furnaces and heaters; location and installation of warm air furnaces and heaters; construction of air ducts; and construction of vents for gas-burning furnaces and chimneys for oil-burning furnaces.

The new requirements pertaining to oil-burning furnaces and heaters are designed to safeguard the rapidly increasing number of houses in Los Angeles using this fuel for central heating.

A public hearing on the heating code has been set by the department for early in May at which time recommended modifications will be considered for inclusion in the code.

Oil-Heat Institute Starts Postwar Planning

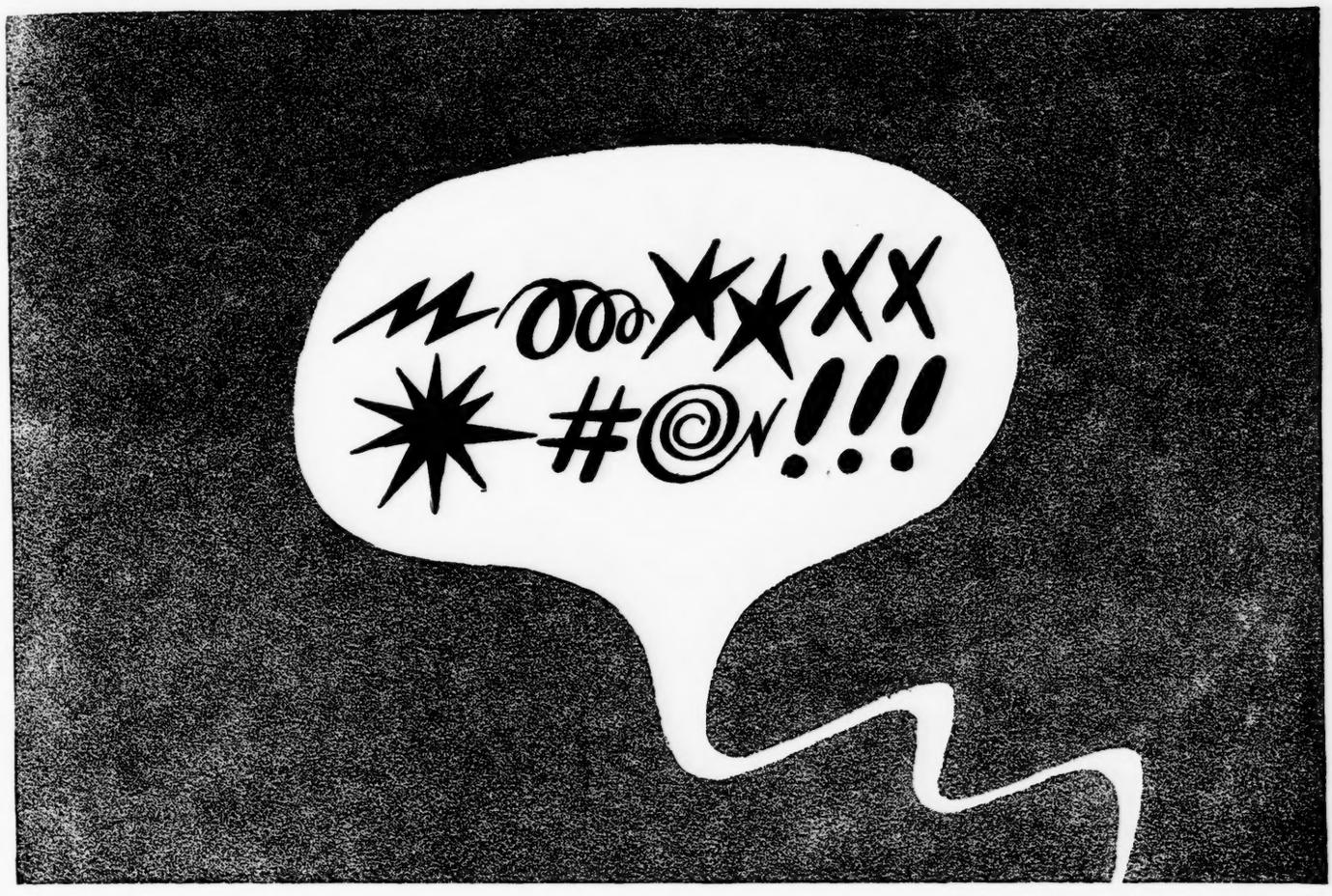
NEW YORK—A committee of postwar planners has been appointed by President C. E. Lewis of Oil-Heat Institute to take under advisement the major issues that will have to be considered and dealt with in the postwar period. The committee met in a full day session May 10 and has already set up its preliminary machinery.

The advisory and postwar planning committee is headed by W. A. Matheson, chairman, Williams Oil-O-Matic. Members are: W. F. Brannan, Anchor Post; Hugh Courteol, Mercoid; Alexis Doster, Torrington Fan; E. A. Halbleib, Delco; W. A. Kemp, Sundstrand Machine; S. A. Loeb, Webster; J. K. Luthe, Perfex; J. H. O'Brien, Petro; Albert Penn, Penn Electric Switch; J. P. Rainbault, General Electric; W. F. Rockwell, Timken; R. M. Sherman, Silent Glow; Harold W. Sweatt, Minneapolis-Honeywell; and G. B. Tuthill, Tuthill Pump.

L. A. Group Hears Talk on Food Dehydration

LOS ANGELES—Local chapters of the ASHVE and the Heating, Piping & Air Conditioning Contractors' Association held a joint meeting April 14, with approximately 65 in attendance. Speaker was Dr. E. A. Beavens, food technologist of fruit and vegetable chemistry of the U. S. Department of Agriculture, whose subject was "Food Dehydration—a Revived Industry."

Wesley Stewart, vice-president of the ASHVE, presided in the absence of president Howard Bullock.



What does a speck of dust sound like?

In a telephone receiver, a speck of dust doesn't sound like anything. Why? Because most automatic telephone exchanges today operate in dust-free air . . . a speck of dust just couldn't get in.

TELEPHONE ENGINEERS realized, many years ago, that a speck of dust or lint could interfere with the proper closing of automatic switches and cause static-like noises during conversation. So now, most men in charge of ventilating systems install Dust-Stop* Air Filters, which keep dust and dirt away from delicate mechanisms.

Plant and maintenance engineers are also well aware of the damage which dust can do to practically any precision instrument. They know that it can interfere with the accuracy of a gun sight . shorten the life of a high-speed motor.

That's why many alert engineers today insist on Dust-Stop filtered air for precision manufacturing operations. For Dust-Stops have proved and are proving their efficiency and economy in scores of important war plants. They are protecting delicate parts from dust damage... guarding accurately machined and carefully painted surfaces.

Outstanding Dust-Stop advantages include:

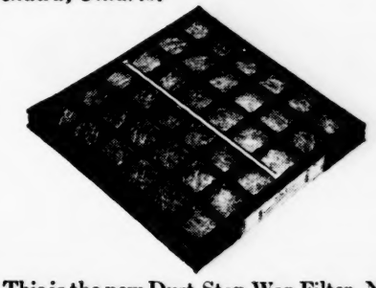
PERFORMANCE: Capacity, 2 CFM per sq. inch of area at 300 FPM. Average resistance, new, in inches of water gauge, .062 for the 1-inch, .13 for the 2-inch.

ECONOMY: Cost only 1¢ per CFM as original equipment for industrial installations. Less than 1/10th of 1¢ per CFM to replace.

MAINTENANCE: Filters can be cleaned by vacuuming or rapping out. This practice can be repeated once or twice to reduce maintenance costs.

AVAILABILITY: Made from all-American materials which are not now listed as critical. Production is being expanded to growing requirements.

Investigate the efficiency and low cost of maintaining dust-free air by replacing Dust-Stops at regular intervals. If your regular supplier cannot give you full technical data, write today to *Owens-Corning Fiberglas Corporation, Toledo, Ohio. In Canada, Fiberglas Canada, Ltd., Oshawa, Ontario.*



• This is the new Dust-Stop War Filter. Note the square grille of heavy Kraft fiberboard. This replaces the metal grille with round openings formerly used.

FIBERGLAS* DUSTOP* AIR FILTERS

*T. M. Reg. U.S. Pat. Off.

Triethylene Glycol Vapor Not Toxic

NEW YORK—Triethylene glycol vapor, which will kill air-borne bacteria in a matter of seconds, is not toxic to human beings and can be used with complete safety, Dr. Oswald H. Robertson, professor of medicine, University of Chicago, stated April 15 in a lecture before the Harvey Society of New York, sponsored by the New York Academy of Sciences.

The experiments on toxicity were the final major step in the series relating to Dr. Robertson's discovery that the glycol compounds in imperceptible vapor form, of one part glycol to 200 million parts of air, will sterilize the atmosphere in buildings where humans congregate and under proper conditions destroy the germs of pneumonia, streptococcus infection, influenza, and quite probably the common cold and other air-borne infections.

At this concentration, which is the saturation point of triethylene glycol, Dr. Robertson's latest experiments have demonstrated that this chemical has no harmful or apparent effect on the bronchial tract, the kidneys, or the liver, as do some other forms, notably ethylene glycol and diethylene glycol. The use of the vapor introduces no fire hazard.

Humidity, Dr. Robertson emphasized in his lecture, is an important factor in the vapor sterilization technique. The infection is spread from infected persons in droplet form by sneezing, coughing, and similar means. The humidity of the atmosphere is necessary to keep the bacteria surrounded by their fluid, because the triethylene glycol molecules, with a high affinity for water, accumulate rapidly around the fluid and "smother" the bacteria by stopping their respiration.

When the bacteria have an opportunity to dry, and are then suspended in the air, the vapor is ineffective except at humidities of 35% or higher, which causes hydration of the bacteria and so permits the glycol action. Hence, dried bacteria may require 15 to 30 minutes to become hydrated and thus susceptible to the killing action of the vapor.

The best humidities for effective action are from 40 to 60%, though humidities as low as 35% are effective, Dr. Robertson found in the experiments. At the higher humidities, the triethylene vapor, if distributed through the atmosphere, will sterilize almost instantly. If the humidity is lowered to 25% the sterilization of the air is appreciably delayed.

Effective use of the vapor sterilization technique, Dr. Robertson said, will depend on engineering methods of obtaining correct humidity. One encouraging factor, however, is that in closed buildings during the winter, when infection is highest, the crowding together of large numbers of people normally increases the humidity through their respiration.

Because of the humidity factor, the vapor method requires control of the rate at which air is changed. When there are frequent and large changes, such as by opening of doors or windows, the control of humidity and concentration of the glycol is rendered more difficult.

M. Brock Williston

JACKSON, MICH.—M. Brock Williston, vice-president in charge of sales, Acme Industries, Incorporated, died at his home here May 4 following a prolonged illness.

Born in Jackson, Mr. Williston for a number of years was engaged in the building supply business in Detroit where he headed his own company. He returned to Jackson to join Acme Industries in 1932. He was widely known throughout the air conditioning and refrigeration industry.

Mr. Williston is survived by his wife and a son.

P. J. Gallagher

FARIBAULT, MINN. — Patrick James Gallagher, heating, plumbing and air conditioning contractor, died here May 11 of a heart ailment. He was 75. Mr. Gallagher was born in Ireland and came to this country at the age of 18. While still a boy he became a plumber's apprentice with the H. Kelly Plumbing Company in Faribault, and in 1895 he established his own business. His company has handled many projects at local State institutions and industrial plants, and in addition, had the contracts for a number of buildings of the University of Minnesota and other institutions throughout the northwest. In the past year this firm has been engaged in war contracts at Camp McCoy, Wis., and Camp Ellis, Ill., and the Heart Mountain Relocation Center.

In 1926 two of his sons, Luke and Robert, graduates of the University of Minnesota, became associated with him as partners. Another son, Edward, is also associated with the company.

Mr. Gallagher is survived by two daughters, four sons, and five grandchildren.

Fred S. Denison

MINNEAPOLIS—Fred S. Denison, engineering executive of the Minneapolis-Honeywell Regulator Company and winner of the National Association of Manufacturers' Pioneer award in 1940, died here at the age of 56.

Mr. Denison was born in Green Leaf, Kan., and came to Minneapolis at the age of eight. He had been with Minneapolis-Honeywell since 1908. He developed that company's line of gravity motors and electric motors, and its present eight-day clock-type thermostat.

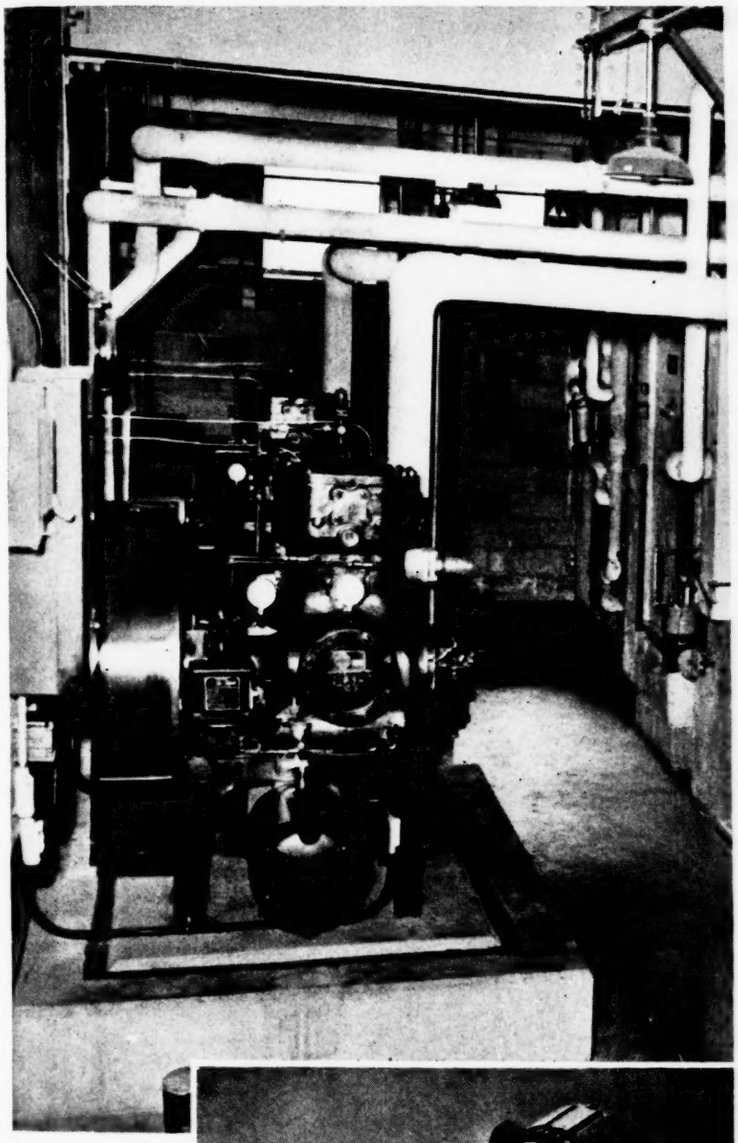
Later he left his position as chief engineer and acted in a consulting engineering capacity for the sales and engineering departments, and more recently took over the active superitendence of the Lake Street Ordnance plant.

Joseph W. Hays

GRINNELL, IA.—Joseph Weller Hays, combustion engineer and founder of what is now The Hays Corporation, died at the family home here April 22 at the age of 75.

EFFICIENT SHELL LOADING NEEDS CONTROLLED ATMOSPHERE

VILTER COMPRESSORS *help furnish it!*



Courtesy of Smith, Hinchman and Grylls, Architects and Engineers, Detroit.

O. W. I. Photo

The Vilter Compressors illustrated here are installed in a large ordnance-producing plant to help in the maintenance of stable atmospheric control in the division where tracer bullets are loaded—where such scientific control is indispensable if the specified powder charge is to give a uniformly effective performance in the cartridge shell. The Vilter Compressors handle the refrigerant (Freon) from the cooling coils which cool and dehumidify the air to proper specifications. This equipment is designed to maintain constant conditions of temperature and relative humidity best suited for the carrying on of the delicate powder handling processes when summer outside conditions are at 95° dry bulb and 75° wet bulb.

New and outstanding engineering features prevent leakage and minimize friction, resulting in extremely low relative hp. per ton and economical operation. Available in a wide range of types and sizes.

The Vilter line is attuned to the wartime needs of manufacturers, engineers and specifiers who have their conditioning problems—routine or unusual—to solve. Seventy-six years of Vilter research, development and experience are an assurance of reliability that such men will appreciate.

THE VILTER MFG. CO.
MILWAUKEE, WISCONSIN
(SINCE 1867)

AIR CONDITIONING AND REFRIGERATION EQUIPMENT for COMFORT COOLING and INDUSTRIAL PROCESSING

DEGREE-DAYS FOR APRIL, 1943

HEATING AND VENTILATING'S 15th year of publication of monthly degree-day data

City	Monthly Degree-Days			Cumulative Degree-Days			Year[1]
	Degree-Days, Apr., 1943	Degree-Days, Apr., 1942	Degree-Days, Apr., Normal	Season, 9/1/42-4/30/43	Season, 9/1/41-4/30/42	Season, Normal 9/1-4/30	Normal, 9/1-6/30
Abilene, Texas	31	79	27	2301	2376	2061	2061
Albany, New York	759	464	549	7109	6212	6397	6580
Albuquerque, New Mexico	163	307	288	3597	4389	4258	4298
Alpena, Michigan	849	549	789	7783	6767	7662	8299*
Anaconda, Montana	611	664	756	7423	7761	7493	8357**
Asheville, North Carolina	365	223	330	4087	3893	4161	4232
Atlanta, Georgia	176	119	132	2865	2895	2890	2890
Atlantic City, New Jersey	562	399	519	4682	4323	4956	5176
Augusta, Georgia	122	80	24	2178	2201	2161	2161
Baker, Oregon	512	550	615	6307	6530	6519	7163
Baltimore, Maryland	437	234	348	4346	3781	4511	4533
Billings, Montana	398	484	534	6779	6629	6743	7119
Binghamton, New York	751	426	594	6599	5811	6554	6808
Birmingham, Alabama	124	89	69	2477	2572	2352	2352
Bismarck, North Dakota	502	570	657	8953	7513	8809	9192
Block Island, Rhode Island	710	586	633	5630	5129	5311	5788
Boise, Idaho	331	398	435	5312	5755	5316	5552
Boston, Massachusetts	649	463	570	5913	5224	5800	6045
Bozeman, Montana	544	647	731	7483	8139	7724	8521**
Buffalo, New York	842	551	675	6864	6003	6475	6822
Burlington, Vermont	859	585	654	7869	7075	7238	7514
Butte, Montana	624	683	741	8049	8536	7424	8272
Cairo, Illinois	235	170	201	3859	3673	3909	3909
Canton, New York	864	545	684	8101	7249	7686	8020
Charles City, Iowa	582	373	612	7816	6391	7364	7588
Charleston, South Carolina	107	74	36	1909	1843	1769	1769
Charlotte, North Carolina	206	122	159	3056	2866	3120	3120
Chattanooga, Tennessee	188	160	144	3251	4381	3118	3118
Cheyenne, Wyoming	505	600	720	6447	6934	6894	7466
Chicago, Illinois	583	370	537	6548	5314	5715	5957
Cincinnati, Ohio	458	279	333	5000	4437	4684	4684
Cleveland, Ohio	649	389	564	5849	5192	5935	6155
Columbia, Missouri	315	204	303	4931	4369	4900	4822
Columbia, South Carolina	145	87	63	2375	2301	2364	2364
Columbus, Ohio	540	325	420	5391	4774	5311	5398
Concord, New Hampshire	800	555	669	7474	6673	7001	7353
Concordia, Kansas	273	253	342	5313	4934	5250	5315
Dallas, Texas	49	74	9	2314	2383	2256	2256
Davenport, Iowa	468	298	453	6389	5344	6171	6289
Dayton, Ohio	578	327	396	5415	4793	5183	5264
Denver, Colorado	291	399	534	4895	5636	5607	5874
Des Moines, Iowa	458	282	441	6469	5534	6266	6384
Detroit, Michigan	679	401	573	6515	5583	6264	6490
Devils Lake, North Dakota	658	669	756	9785	8326	9450	9970
Dodge City, Kansas	235	298	342	4711	4660	4988	5035
Dubuque, Iowa	517	328	489	6961	5693	6641	6790
Duluth, Minnesota	806	619	801	9165	7687	8746	9443
Eastport, Maine	871	718	786	7546	6993	7398	8520**
Elkins, West Virginia	621	368	501	5454	5130	5520	5697
El Paso, Texas	54	97	45	2200	2389	2428	2428
Ely, Nevada	507	703	(a)	6095	7389	(a)	(a)
Erie, Pennsylvania	725	407	609	6139	5397	6016	6273
Escanaba, Michigan	885	633	828	8311	7080	8118	8771*
Evansville, Indiana	357	247	276	4726	4311	4244	4244
Fort Smith, Arkansas	101	94	93	3075	3093	3147	3147
Fort Wayne, Indiana	634	379	474	6483	5627	5795	5925
Fort Worth, Texas	44	77	27	2311	2375	2148	2148
Fresno, California	107	163	135	2398	2442	2334	2334
Galveston, Texas	7	27	0	1046	1321	1016	1016
Grand Junction, Colorado	165	322	384	4565	5437	5430	5548
Grand Rapids, Michigan	655	374	534	6582	5598	6361	6535
Green Bay, Wisconsin	720	456	600	7859	6488	7503	7825
Greensboro, North Carolina	309	195	210	3823	3647	3529	3529
Greenville, South Carolina	208	127	195	3105	2970	3380	3380
Harrisburg, Pennsylvania	572	303	405	5313	4772	5285	5357
Hartford, Connecticut	665	433	531	6240	5542	5834	6036
Hatteras, North Carolina	241	185	255	2518	2400	2571	2571
Havre, Montana	437	525	630	7988	7240	8187	8700
Helena, Montana	533	585	646	7953	7964	7261	7898
Houston, Texas	16	28	0	1212	1406	1157	1157
Huron, South Dakota	526	424	570	8023	6601	7737	8004
Indianapolis, Indiana	518	275	384	5618	4664	5239	5298
Ithaca, New York	794	446	606	6671	5933	6477	6719
Kansas City, Missouri	254	185	306	4911	4334	4950	4956
Kewanee, Illinois	534	234	381	6763	4944	5512	6139
Knoxville, Tennessee	267	171	210	3663	3489	3670	3670
La Crosse, Wisconsin	617	345	528	7786	6141	7139	7322
Lander, Wyoming	455	530	690	7024	7917	7384	7947

[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

Figures in this table, with eight exceptions, based on local weather bureau reports. Exceptions are Utica, Lewiston, Kewanee, and Sioux City, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y.; Norman E. Ross, Bursar, Bates College, Lewiston, Me.; J. M. Hartman, Engineering Department, Kewanee Boiler Corp., Kewanee, Ill., and Alfred R. Wagstaff, Engineer, Sioux City Foundry and Boiler Co., Sioux City, Iowa, respectively; Anaconda, Bozeman, Butte and Livingston, Mont., through the courtesy of the Montana Power Company.

(a) Data not available.

[Table Concluded on Page 106]

We also manufacture
all types of Steam Unit Heaters

DIRECTHERM
UNIT HEATERS

squeeze the most out of coal, gas or oil. They utilize 80% of the fuel energy and distribute the heat evenly as far away as 200 feet.

Directherm Heaters solve many important war problems. They save metal, they save man power, they save fuel. Installation is easy, no ducts, pipe, or radiators are needed. Automatic controls eliminate maintenance.

For coal, gas and oil. Made in 6 sizes (300,000 – 1,700,000 BTU)

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MANUFACTURING COMPANY

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AIR CONDITIONING NOZZLES

Nozzles of unique Yarway Involute Design.

No internal parts or vanes to clog or erode.

Insure trouble-free air washing service.

Sizes and types for all requirements.

Many large users—installations total more than 5 million gallons per minute in water cooling and air conditioning service. Write for Bulletin N-616.

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104 MERMAID AVENUE
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YARWAY

THE HURRICANE BLEW IT OFF *but*
2 FLOORS NOW DO THE WORK OF THREE WITH Sarco

The hurricane blew the top floor of the New England Overall Company to the ground. A rearrangement of machines – plus a speed-up produced by all-Sarco steam traps and controls – enabled this company to do more business with two floors than they formerly did with three.

The owner says: "If you have three wash wheels, you should be able to load them up all at the same time. If your plant is full of presses, pants stretchers, tumblers, etc., no one machine should be slowed up by any or all of the others. Our contractors advised a separate Sarco steam trap for each machine – we know now it would have been folly to do it any other way. I know what steam costs and what it costs to have operators wait. I'll spend a dollar to save ten anytime." Catalog No. 350.

145

SARCO SAVES STEAM

SARCO COMPANY, INC.
475 Fifth Avenue, New York, N. Y.
Sarco Canada Ltd., Federal Bldg., Toronto, Ont.

Degree-Days for April, 1943 (Concluded)

HEATING AND VENTILATING'S 15th year of publication of monthly degree-day data

City	Monthly Degree-Days			Cumulative Degree-Days			Year[1]
	Degree-Days, Apr., 1943	Degree-Days, Apr., 1942	Degree-Days, Apr., Normal	Season, 9/1/42-4/30/43	Season, 9/1/41-4/30/42	Season, Normal 9/1-4/30	Normal, 9/1-6/30
Lansing, Michigan	718	420	582	7047	5992	6819	7048
Lewiston, Maine	776	620	693	7560	6947	7318	7707
Lincoln, Nebraska	343	266	417	5874	5324	5900	5999
Little Rock, Arkansas	126	111	78	3044	2979	2811	2811
Livingston, Montana	449	599	653	6672	7015	6638	7205
Los Angeles, California	130	168	159	1081	1230	1414	1504
Louisville, Kentucky	371	214	264	4458	3991	4180	4180
Lynchburg, Virginia	339	187	273	3859	3529	3980	3980
Macon, Georgia	127	92	32	2243	2384	2201	2201
Madison, Wisconsin	624	408	582	7488	6201	7193	7429
Marquette, Michigan	863	519	804	8198	6932	7968	8693*
Memphis, Tennessee	161	113	96	3157	3227	2950	2950
Meridian, Mississippi	87	72	24	2179	2430	2160	2160
Milwaukee, Wisconsin	671	469	648	7269	6209	6856	7245
Minneapolis, Minnesota	621	400	570	8229	6557	7614	7850
Modena, Utah	424	570	579	5527	6497	6170	6562
Montgomery, Alabama	76	60	0	1922	2155	1884	1884
Nantucket, Massachusetts	694	578	639	5598	5149	5450	5957
Nashville, Tennessee	252	147	180	3622	3404	3507	3507
New Haven, Connecticut	647	431	543	5755	5091	5672	5895
New Orleans, Louisiana	21	26	0	1205	1349	1024	1024
New York, New York	589	360	486	5146	4621	5192	5347
Nome, Alaska‡	1667	1783	1756	10801	9101	10642	14580**
Norfolk, Virginia	309	208	246	3158	3005	3350	3350
Northfield, Vermont	906	630	756	8263	7446	8137	8719*
North Head, Washington	467	462	516	4111	3880	4271	5452**
North Platte, Nebraska	345	350	486	5773	5837	6167	6366
Oakland, California	271	310	273	2532	2510	2665	3143**
Oklahoma City, Oklahoma	93	136	162	3454	3335	3613	3613
Omaha, Nebraska	349	271	414	6124	5577	6047	6131
Oswego, New York	835	533	675	6900	6136	6668	7088
Parkersburg, West Virginia	488	274	351	4858	4448	4722	4775
Peoria, Illinois	488	304	453	6109	5166	5988	6109
Philadelphia, Pennsylvania	521	292	402	4799	4253	4787	4855
Phoenix, Arizona	41	50	0	1013	1402	1405	1405
Pittsburgh, Pennsylvania	560	310	423	5195	4668	5157	5235
Pocatello, Idaho	378	525	567	5981	7229	6263	6655
Portland, Maine	804	610	666	7409	6678	6771	7218
Portland, Oregon	286	323	402	3784	3826	4134	4469
Providence, Rhode Island	632	445	558	5755	5180	5764	6015
Pueblo, Colorado	267	399	456	4919	5595	5328	5514
Raleigh, North Carolina	238	153	183	3181	3013	3234	3234
Rapid City, South Dakota	442	449	594	6950	6226	6744	7118
Reading, Pennsylvania	556	304	417	5219	4650	5293	5389
Redding, California	181	143	156	2456	2590	2451	2451
Reno, Nevada	430	523	534	4865	5417	5436	5892
Richmond, Virginia	343	199	246	3747	3528	3695	3695
Rochester, New York	793	460	618	6853	6087	6472	6732
Roseburg, Oregon	315	374	411	3527	3747	4047	4428
Roswell, New Mexico	86	197	180	2896	3456	3484	3484
Sacramento, California	174	238	207	2433	2513	2600	2653
St. Joseph, Missouri	300	205	342	5326	4771	5145	5161
St. Louis, Missouri	312	204	276	4583	4077	4585	4585
Salt Lake City, Utah	283	437	453	5195	5956	5319	5555
San Antonio, Texas	6	23	0	1408	1507	1202	1202
San Diego, California	122	141	174	1083	1193	1524	1645
Sandusky, Ohio	643	377	726	6010	5212	6025	6208
San Francisco, California	282	284	294	2222	2136	2417	3264**
Sault Ste. Marie, Michigan	947	634	819	7419	7838	8448	9285**
Savannah, Georgia	80	41	0	1556	1546	1490	1490
Scranton, Pennsylvania	708	385	513	6199	5463	5958	6129
Seattle, Washington	341	366	462	4009	3841	4379	4934**
Sheridan, Wyoming	393	513	648	6844	6980	7485	8008
Shreveport, Louisiana	50	40	0	2106	2273	1938	1938
Sioux City, Iowa	465	359	489	7002	6159	6734	6898
Spokane, Washington	438	455	504	6055	6050	5989	6355
Springfield, Illinois	393	246	366	5376	4631	5317	5373
Springfield, Missouri	293	195	267	4569	4318	4416	4428
Syracuse, New York	796	453	630	6944	6060	6614	6893
Tacoma, Washington	382	388	465	4312	4179	4551	5181**
Terre Haute, Indiana	410	256	333	5171	4519	4872	4872
Toledo, Ohio	668	369	525	6368	5434	5897	6077
Topeka, Kansas	237	188	300	4916	4441	4935	4969
Trenton, New Jersey	568	333	402	5207	4648	4852	4933
Utica, New York	810	483	588	7188	6402	6543	6796
Valentine, Nebraska	416	433	561	6806	6381	6766	7039
Walla Walla, Washington	294	294	363	4680	4717	4637	4808
Washington, D. C.	414	229	348	4303	3877	4601	4626
Wichita, Kansas	187	206	252	4653	4334	4673	4673
Williston, North Dakota	531	565	669	8979	7637	8907	9323
Winnemucca, Nevada	370	527	539	5127	5960	5950	6427**
Yakima, Washington	318	330	360	5422	5151	5413	5599

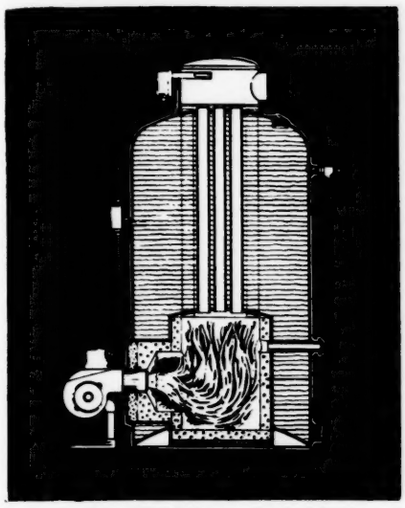
‡Nome data are for March.

*Includes August **Includes July and August

[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

Hot bath and shaving water for the Army and Navy

Uncle Sam buys **AQULUX WATER HEATERS**



AQULUX
Heavy Duty
WATER HEATERS

Hot water builds military morale. Uncle Sam is supplying it as generously as possible at American camps and posts throughout the world.

It is a matter of pride to us that Johnson-built Aqulux Water Heaters have been chosen for so many of these government installations.

The exceptional performance and fuel-economy of Aqulux Heaters was a determining factor in their selection. Government procurement officers were guided by the *80% Efficiency Rating, the rapid recovery* and the *low operating costs* we have achieved in these unjacketed, uninsulated, ungalvanized wartime models.

Though virtually all of our capacity is being devoted to these government orders, we are endeavoring whenever possible, to take care of the needs of essential private industries.

If you have a water-heating or oil-burner problem, we will gladly help you with all the manufacturing facilities and engineering experience at our disposal.

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S. T. JOHNSON CO.

40 years of engineering and building fine Oil Burning Equipment

Another WING *Product*

WING REVOLVING UNIT HEATERS

Wing Revolving Unit Heaters insure uniform mixture and circulation of heated air by the use of discharge outlets which revolve slowly and project the streams of heated air to the working level sweeping around in a complete circle. As the moving air circulates along the working level, it mixes uniformly with the cold air, circulates around heavy machinery and obstructions and penetrates into cold, damp corners—insuring a comfortable uniform temperature throughout the entire plant. These Wing Revolving Heaters are suitable for all types and sizes of buildings because the deflectors on the discharge outlet can be adjusted to propel the air in two different concentric circles which permits coverage of a great area.

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DE-STA-CO
Blower Wheel Housings
of Standard Dimensions

Made in sizes to fit 4½, 5, 6, 7½ and 9 inch wheels and in widths to suit single or double inlet wheels . . . also individual parts for your own assembly.

De-Sta-Co housings are engineered for maximum efficiency and quietness in operation . . . neatly finished. Send for "De-Sta-Co Blower Housings" bulletin; gives complete information, including essential dimensions.

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REVIEWS of TECHNICAL publications

MARINE VENTILATION AND HEATING

"Modern Marine Engineer's Manual", Vol. II. Published by Cornell Maritime Press, New York. Price, $4.

The welcome accorded the first volume of this manual has led to publication of a second which includes in its eleven chapters several which will be of direct interest to heating, ventilating and air conditioning engineers. Chapter 18, on Ventilation, prepared by John W. Markert, Chief of the Ventilation & Heating Branch of the U. S. Maritime Commission, is especially well done and contains valuable and helpful information on ventilation requirements, duct design, insulation and its relation to ventilating and heating, and kindred subjects as applied to ships. Other chapters which will be of especial interest to the industry are those on Marine Refrigeration, Insulation, Heating, and Instruments.

Bound in cloth. 5 x 7¼ in. 1210 pages.

POST-WAR HEATING

"Will the Heating Industry Make the Most of Its Post-War Opportunities?", by William E. McFee. Published by the American Rolling Mill Co., Middletown, Ohio.

A stimulating and frank discussion of the problems and opportunities which will confront the heating and air conditioning industry at the close of the war is given in this article appearing in the June, 1943, issue of "Ingot Iron Shop News", the Company's house organ. The importance of and probable trends in indoor climatizing or the science of providing healthful indoor climates, are interestingly explained. The part which prefabrication of completely packaged and easily installed units will play in providing necessary indoor comfort conditions is clearly set forth. The author also emphasizes the desirability for all groups of the industry, including manufacturers, dealers, and material suppliers, to unite in a common program. In this connection, he suggests a program of five basic points which should be followed.

WATER TANK STANDARD

"Recommended Commercial Standard for Porcelain Enameled Tanks for Domestic Use," TS-3488. Published by the U. S. Department of Commerce, National Bureau of Standards, Washington, D. C.

This new standard, adopted by the General Conference of April 22, 1943, covers steel or iron porcelain enameled hot water storage tanks for domestic use in sizes of 15 to 80 gallons, for maximum pressures of 300 lb per sq in.

REFRIGERATION

"Refrigerating Data Book and Catalog"—1942. Published by The American Society of Refrigerating Engineers, New York. Price, $4 in the United States and $4.50 elsewhere.

Printed in a new type of page form and giving new treatment to much of the basic information on refrigeration contained in previous issues, the 1942 edition reverts back to the single-volume style used prior to 1939. The book is made up of five main parts, the first dealing with compression and absorption refrigerating systems, properties and tables of refrigerants, and a glossary. Basic mathematical and physical tables, insulation data, load calculations, and theory of freezing are covered in the second part; the third explains the operation of component parts of typical industrial systems, while in the fourth section the same phases are covered for domestic-commercial systems. The fifth section covers refrigeration in air conditioning and has a final chapter devoted to cooling towers.

Cloth binding; 680 pages, size, 6½ x 9 in.

VENTILATING MAGNESIUM FOUNDRIES

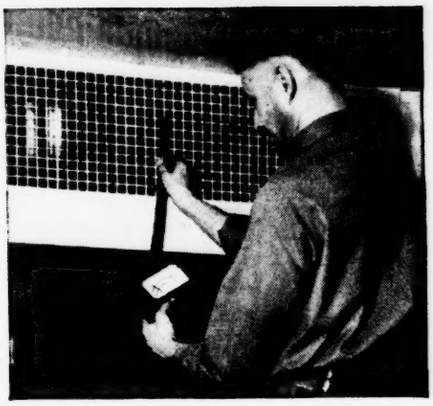
"Atmospheric Contamination from the Casting of Magnesium," by Charles R. Williams. Reprinted from the "Journal of Industrial Hygiene and Toxicology," Vol. 24, No. 9, Nov. 1942, Mt. Royal and Guilford Ave., Baltimore, Md.

The increasing number of foundries now producing magnesium alloy castings as part of the war effort calls for added vigilance to deal with characteristic new health hazards which have arisen. Chief among the atmospheric hazards are concentrations of fluorides resulting from the use of oxidation inhibitors and fluxes in the melting operations. Inhibitors may be any of a group of soluble fluoride salts, or combinations of them, or sulphuric acid, boric acid or borax. The fluxes usually used are complex ammonium fluorides. Inhibitors are added to the sand, sprayed on cores, applied to crucibles just before pouring, or shaken on gates and risers after pouring.

In this paper, the author, who is industrial hygienist for Liberty Mutual Insurance Company, and instructor in industrial hygiene, Harvard School of Public Health, discusses exposure, suggestions for fume collection, and allowable concentrations encountered in typical foundry operations, including moulding, melting, sand conditioning, pouring, shaking out, and casting finishing.

Eight pages, 6¾ in. x 10 in. paper covered.

Alnor VELOMETER



★ all purpose air velocity meter

Instantaneous, direct readings of air speed measured in feet per minute with the *Alnor* Velometer give you the quick, accurate information on air movement needed to check operation of blowers, fans, air conditioning installations, and similar equipment. No calculations, no timing, no conversion tables; read velocities direct from the Velometer scale. Extension jets permit accurate readings in many locations that would be completely inaccessible with other means of measurement.

The Velometer is made in several standard ranges from 20 fpm to 6,000 fpm, and up to 3 inches static or total pressure. Special ranges available as low as 10 fpm and up to 25,000 fpm velocity and 20 inches pressure.

Write for Bulletin No. 2448-E.

Illinois Testing Laboratories Inc.

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DEPENDABILITY

for day after day, year after year service . . . Proved by thousands of users everywhere

FIRE-GUARD

Automatic Coal Stokers

Industrial Sizes: 70, 100, 150, 200, 300 and 400 pounds per hour capacity

--also built in domestic sizes

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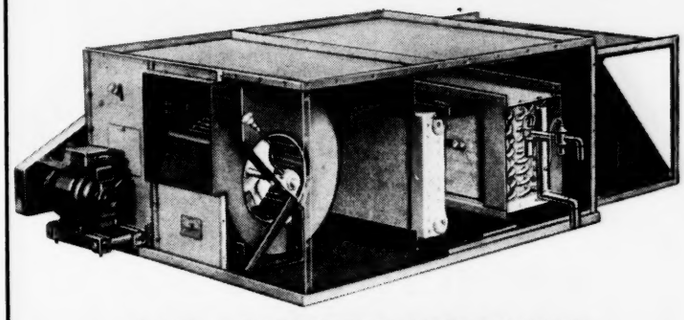
STREAMAIRE



AIR CONDITIONING FOR VITAL WARTIME NEEDS

Control of temperature, humidity and air circulation for precision production, food preservation and health maintenance is a war-time requirement. So important is this need that Government Agencies will grant priorities for air conditioning equipment to control these factors. Young STREAMAIRE air conditioning units provide the essential elements necessary for proper air treatment, in a completely engineered and tested arrangement. Consult with Young engineers on your specific problem.

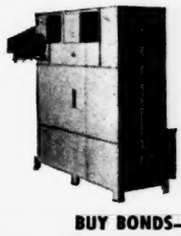
YOUNG RADIATOR COMPANY

DEPT. 103-F, RACINE, WIS., U. S. A.

PRECISION PRODUCTION—The need for air conditioning in the manufacture of essential precision instruments, tools or products is recognized as a necessity of tolerance control. It is also approved for the maintenance of workers' health where conditions of unavoidable heat or contamination of air exist.

FOOD PRESERVATION—Air conditioning equipment for handling, sorting and storage rooms, when essential to maintaining the edibility and nourishment content of food will be permitted. Such equipment is particularly valuable in the preparation for processing by dehydration and quick freeze methods.

HOSPITALS and LABORATORIES—Specific authorization is given for air conditioning equipment for research, testing and analytical laboratories; for hospital rooms used for surgical operations, X-ray or critical convalescent treatment: and for the production and storage of drugs and biological products.



YOUNG *STREAMAIRE* air conditioning units are made in eight horizontal and eight vertical models, with capacities ranging from 400 to 16,625 cfm . . . built for top performance in every size and type of installation. For cooling, heating and air conditioning.

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SALVAGE SCRAP—WIN THE WAR

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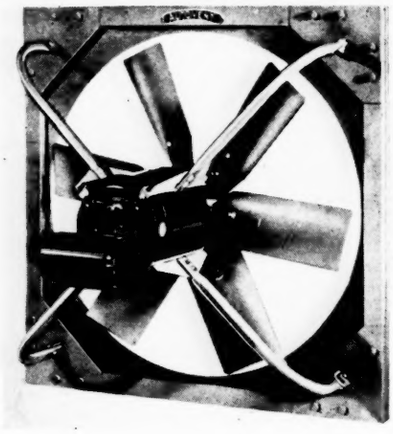
OIL COOLERS • GAS, GASOLINE, DIESEL ENGINE COOLING RADIATORS • INTERCOOLERS • HEAT EXCHANGERS • ENGINE JACKET WATER COOLERS • UNIT HEATERS • CONVECTORS • CONDENSORS • EVAPORATORS • AIR CONDITIONING UNITS • HEATING COILS • COOLING COILS

NEW EQUIPMENT

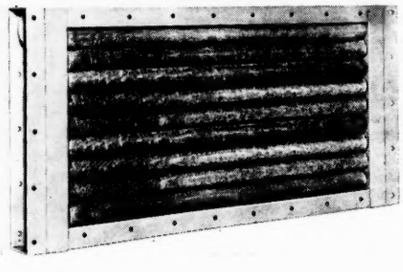


Propeller Fans

NAME—Autovent propeller fans.
PURPOSE—For air moving.
FEATURES—A new and more complete line of propeller fans featuring a non-metallic panel which gives quieter operation, longer life and easier installation, according to the manufacturer. Direct drive fans with totally enclosed motors are available in 18 standard sizes with wheel diameters from 10 to 48 in. and high powered direct drive fans for use against resistance pressure come in 16 sizes with diameters from 12 to 48 in. Standard and high-powered belt drive made in six sizes with wheels of 24 to 54 in. diameters. Non-ferrous wheels and explosion-proof motors are available for hazardous atmospheres and wheels can be given acid-resisting coating for acid conditions.
MADE BY—*Autovent Fan & Blower Division, The Herman Nelson Corp., Moline, Ill.*

Heating Coils

NAME—Industrial Blast Coils.
PURPOSE—For air heating in heating, ventilating, air conditioning or process work.
FEATURES—Steel construction throughout with heavy welded steel header, ½ in. thick on tube side. Individual tubes consist of a continuous steel ribbon wound spirally on a tube in such a way as to form a positive and perfect contact between the fin and the tube. The entire fin and tube assembly is then bonded metalically in a solder bath to form an integral unit. Heavy tubes (.058 in. wall) expanded into headers. Two styles of casings available for convenience in installation. Construction provides for proper drainage when installed in any position. For steam pressures up to 150 lb.
SIZES—Seven casing widths range from 18 in. to 37 in. Length from 24 in. to 102 in. in 6 in. multiples. One, two or three rows deep available.
MADE BY—*Industrial Manufacturing & Engineering Company, 3845 N. Ravenswood Avenue, Chicago, Ill.*

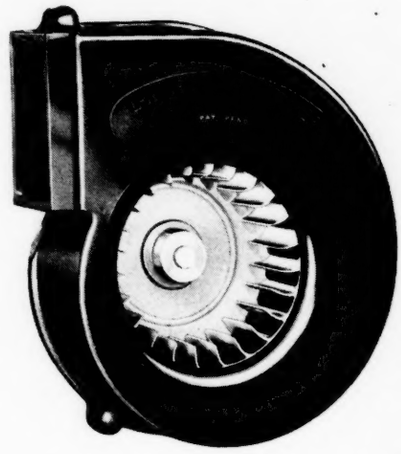


High Temperature Insulation

NAME—Mascolite.
PURPOSE—For high temperature pipe covering and block insulation.
FEATURES—Mascolite is a basic-bonded, vermiculite body designed for temperatures below 2000F. It is extruded, cured, and processed at high speed. Freedom from shrinkage in service and from damage by water, a high insulating efficiency, good strength, and close conformance to specified dimensions are among the advantages claimed for it. A corrugated inner surface provides an air film between hot pipe and main portion of covering.
SIZES AND CAPACITIES—Pipe covering in a complete range of sizes and thicknesses, and a full assortment of insulating slabs and shapes is scheduled for production in June.
MADE BY—*Munn and Steele, Inc., 130 Lister Ave., Newark, N. J.*

Plastic Blower

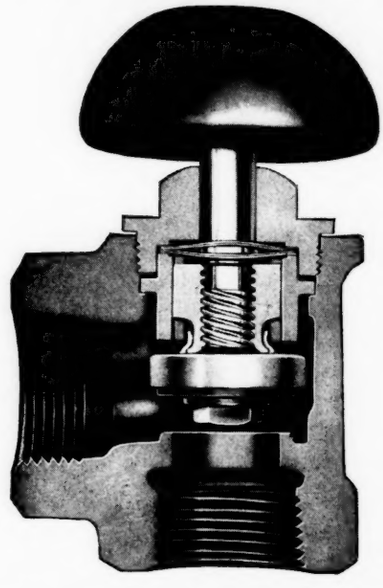
NAME—Model No. 3 plastic blower.
PURPOSE—For miscellaneous blower work.
FEATURES—Has a one-piece high impact type of plastic housing capable of withstanding 230F, and a 3/32 in. thick laminated paper-based motor plate. Wheel is of turbo type, 3 in. in diameter, zinc plated, with 1/4 in. or 5/16 in. shaft bore and two set screws. Motor plate and housing designed for easy mounting on motor by means of brackets or plates. Weight of housing and wheel, 12 oz.



SIZES AND CAPACITIES—Outlet opening, 2½ x 2½ in.; motor requirements, 1/25 to ½ brake horsepower; 3000 to 10,000 rpm; 0 to 4.5 in. static pressure.
MADE BY—*L-R Manufacturing Co., Torrington, Conn.*

Cast Iron Radiator Valve

NAME—Victory packless radiator valve.
PURPOSE—To save critical brass.
FEATURES—Has all cast iron body and cover, with female inlet and outlet connections and left hand outlet thread with right hand inlet. Available in angle pattern only. Has an all-metal packless seal made of two spring steel wafers which are claimed to give a permanent leak-proof seal on pressure or vacuum. Stem has a molded non-heat conducting composition handle.
SIZES—Made in ¾ in. and 1 in.
MADE BY—*Jas. P. Marsh Corporation, 2073 Southport Ave., Chicago, Ill.*



Positive Ventilation of Ordnance Plants assured by

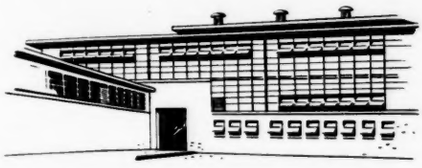
BIFURCATOR ROOF VENTILATORS

These Bifurcator roof ventilators exhaust the hazardous detergent and acid fumes from bullet case washers. Installation is typical of those in other ordnance plants.

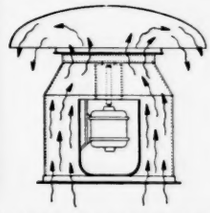
POSITIVE VENTILATION is assured with Bifurcator roof ventilators regardless of temperature, humidity or wind velocity.

LIGHT-PROOF — Bifurcators are continually "blacked-out." No adjustment necessary.

MOTOR IS PROTECTED against burning out by the non-overloading power characteristics of the DeBothezat axial-flow fan.



Smith, Hinchman and Grylls, Architects and Engineers, Detroit



MOTOR ISOLATED FROM FUMES — air stream is bifurcated, or forked so it passes *around* the through-ventilated motor chamber.

DeBothezat

VENTILATING EQUIPMENT

DIVISION OF AMERICAN MACHINE AND METALS, INC., EAST MOLINE, ILLINOIS

We Didn't Want to Make Strainers

BUT we needed them for use with the Yarway Steam Equipment and couldn't find any to suit us.

So we designed the *YARWAY Strainer.*

Apparently a lot of other people were having "Strainer trouble" because, without a line of advertising, the Yarway Strainers *purchased* in a few years now number *many thousands.*

Why don't you look into this better Strainer for your money? Buy one from your supply house (over 100 Mill Supply Houses now have them).

See its protection against corrosion—*cadmium plating inside and out.*

Examine its *high grade Monel woven wire screen* that stops dirt—lets condensate or other fluids flow freely.

Notice the removeable blow-off bushing. Screen and bushing come out together—go back together, *automatically aligning.*

Six standard sizes from ½" to 2" for pressures to 600 lb.

See your Mill Supply House or write for Bulletin S-200.

YARNALL-WARING COMPANY
104 Mermaid Ave. PHILADELPHIA

YARWAY Strainers

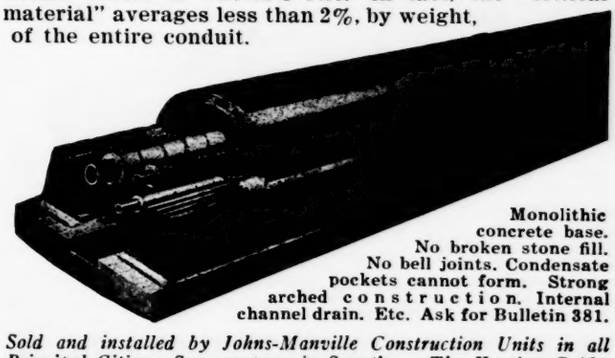
Less Than **2%** **"Critical Material"** *in*

THERM-O-TILE

Reg. U. S. Pat. Off.

Underground Pipe Conduit

The most important test for every decision today is: "Will it help win the war?" Applied to Therm-O-Tile the answer is definitely "Yes". You save MUCH metal when you use this conduit. Pipe supports are the ONLY metal in Therm-O-Tile. In fact, the "critical material" averages less than 2%, by weight, of the entire conduit.



Monolithic concrete base. No broken stone fill. No bell joints. Condensate pockets cannot form. Strong arched construction. Internal channel drain. Etc. Ask for Bulletin 381.

Sold and installed by Johns-Manville Construction Units in all Principal Cities. See our page in Sweet's or The Heating Guide.

H. W. PORTER & CO., Inc.

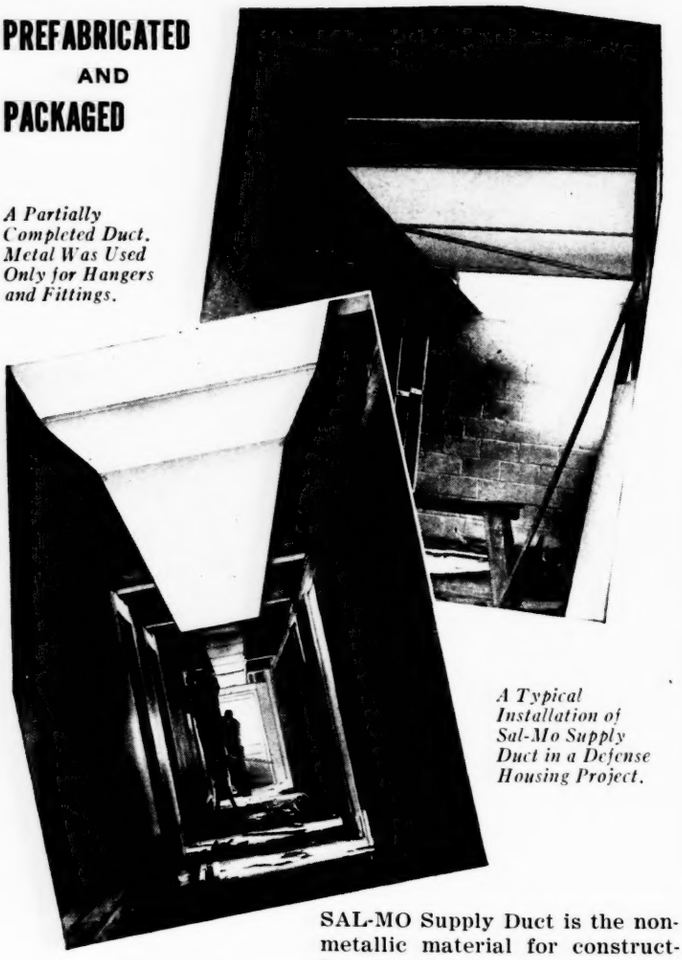
823-V Frelinghuysen Ave., Newark, New Jersey

Without obligating us in any way, ☐ Please send Bulletin 381. ☐ Send representative. ☐ Enclosed is a sketch, with principal data of a prospective job, on which we shall be glad to have your ☐ comments, ☐ quotations.

Clip your name, firm, and address to this ad; tear out with the checked squares above, mail, and you will hear from us promptly.

SAL-MO SUPPLY DUCT

PREFABRICATED AND PACKAGED



A Partially Completed Duct. Metal Was Used Only for Hangers and Fittings.

A Typical Installation of Sal-Mo Supply Duct in a Defense Housing Project.

SAL-MO Supply Duct is the non-metallic material for constructing supply and return ducts for Warm Air Heating, Ventilating and Air Conditioning Systems. Its use permits many installations that would otherwise be impossible because of the Government rulings restricting the use of metals.

Sal-Mo Supply Duct is prefabricated and packaged in cartons at the factory. It is quickly installed, saving many hours in erecting time. It also reduces shipping, trucking and storing costs to a minimum.

Ducts constructed of Sal-Mo Supply Duct are tight, quiet and insulated. Low conductivity rate assures efficient operation in both heating and cooling systems. Smooth interior surfaces give low friction loss. Air tight construction prevents heat loss.

APPROVED AND LISTED by Underwriters Laboratories, Inc.

Sal-Mo Supply Duct is tested for Fire Hazard Classification; Inflammability; Fire Retardant Classification; Fire Spread; Moisture Absorption. It has a "K" Factor of 0.294 B. T. U. Available in 26 sizes for domestic and industrial installation, and in flat sheets.

Sall Mountain Company also manufactures Asbestos Paper, Millboard, Pipe Tape, Pipe Coverings and many other Insulation Materials.

Phone Andover 2414

SALL MOUNTAIN COMPANY

176 W. Adams St. Dept. B Chicago

NEW CATALOGS

BLOWERS

L. J. Wing Mfg. Co., 154 West 14th St., New York.

Bulletin CO-5, standard size, 8 pages, illustrates a number of typical installations and includes descriptive matter on single and two-stage axial flow blowers. Both types are equipped with built-in volume control vanes.

CONDENSERS AND COOLERS

General Electric Company
Bloomfield, N. J.

An 8-page standard size booklet, printed in two colors, describes the company's new line of evaporative condensers and coolers. General application information, a discussion of special features, and a summary of specifications are given.

UNIT COOLERS

Kramer Trenton Co., Trenton, New Jersey

Bulletin No. R-143, 2 pages, standard size, illustrates and describes the Victory Model Coolmaster, suitable for use with Freon, methyl, sulphur, ammonia, or brine. Performance data, dimensions, and list prices are included.

UNIT HEATERS

D. J. Murray Mfg. Company
Wausau, Wisconsin

A new standard size catalog sheet gives detailed data on the company's line of Grid cast-iron unit heaters introduced last year.

BLOWERS

Roots-Connersville Blower Corp., Connersville, Indiana.

Bulletin No. 120-B-12, standard size, 20-pages, explains and illustrates the operation of centrifugal blowers and exhausters in both single and multi-stage types. Performance curves and dimensional data are included.

PIPE AND STEEL DATA

The Babcock & Wilcox Tube Company, Beaver Falls, Pa.

Technical Data Card No. 107B listing revised standard specifications for seamless tubes and pipe, is available upon application to the manufacturer on a company letterhead or by stating company connection.

Also available is TDC-119A listing standard steels of the American Iron and Steel Institute and the Society of Automotive Engineers, Inc.

WATERWASH BOOTHS

Aqua-Restor Division, Mayer Mfg. Corp.,
50 Division Place, Brooklyn, N. Y.

A standard size, 4-page folder illustrates and describes the company's line of waterwash spray booths used in dust collection systems and for fume removal and pigment recovery in spray painting systems.

TRAPS

The Strong, Carlisle & Hammond Co., Cleveland, Ohio.

Catalog No. 66, consisting of 24 standard size pages printed in two colors, illustrates and describes traps and miscellaneous drainage equipment. Bucket and thermostatic types of steam traps, as well as special bucket traps for gasoline, oil, ammonia and other liquids, are covered.

CONTROLS

C. J. Tagliabue Mfg. Co., Brooklyn, New York.

New catalog No. 1200, 42 pages, standard size, describes the company's three types of controls, for on-off, throttling, and automatic reset operation. Booklet is profusely illustrated and gives complete information on control elements, valves, charts, and other accessories, in addition to the control instruments.

MOTOR CONTROLS

General Electric Company, Schenectady, N. Y.

Bulletin GEA-4015, standard size, 16 pages, is a simplified guide to the selection and application of commonly used motor controls. Describes operation of standard controls and explains distinctions between manual and magnetic devices.

WATER TREATMENT

Cochrane Corporation, 17th & Allegheny Ave., Philadelphia, Pa.

Publication 4009, standard size, 8 pages, is a new illustrated bulletin dealing with proportioning equipment of the double displacement type for the continuous feeding of water treating solutions into boiler feed water. The apparatus described is designed for the incorporation of a pH controller.

UNIT HEATERS

Carrier Corporation, Syracuse, New York.

New specification sheets describing horizontal and vertical discharge type unit heaters have just been issued. Sheet 46-E gives ratings and dimensional data on the horizontal type and 46-S covers the five-way vertical type.

WITH THE MANUFACTURERS

SKF INDUSTRIES

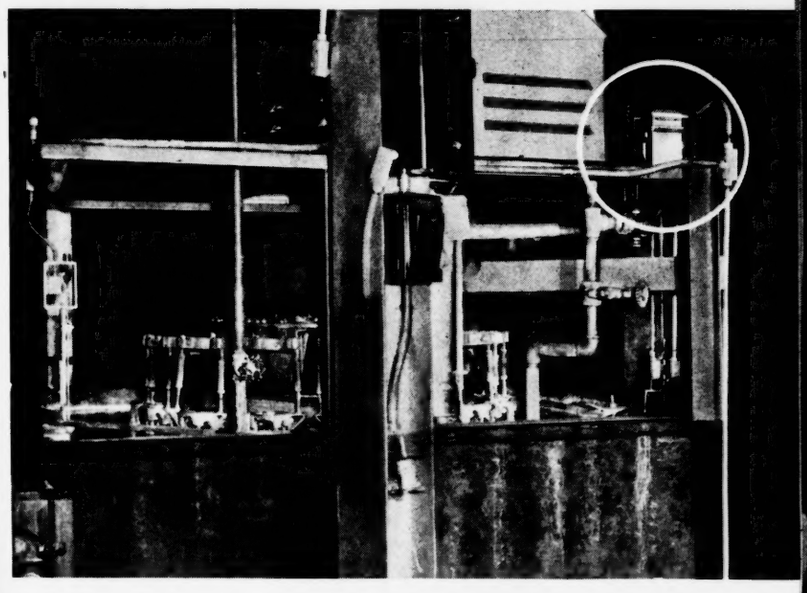
has announced three executive promotions, following a recent meeting of the board of directors: Thomas W. Dinlocker was elected vice-president and treasurer, Richard H. DeMott vice-president in charge of sales, and C. P. Collins, secretary. William L. Batt, vice-chairman of WPB, retains the presidency.

(Concluded on page 114)

BARBER-COLMAN

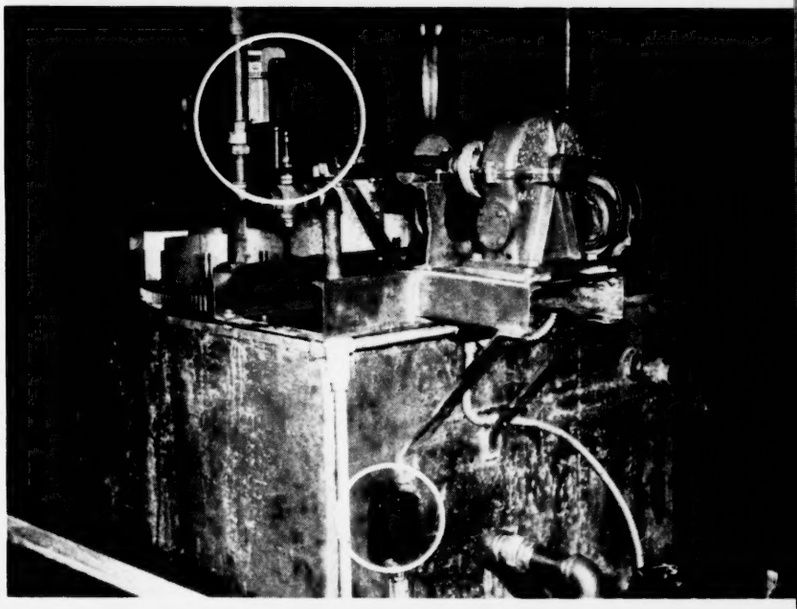
MAXIMUM SERVICE Controls BARBER-COLMAN COMPANY MINIMUM MAINTENANCE

GRILLES & REGISTERS
AIR DIFFUSERS
AUTOMATIC CONTROLS



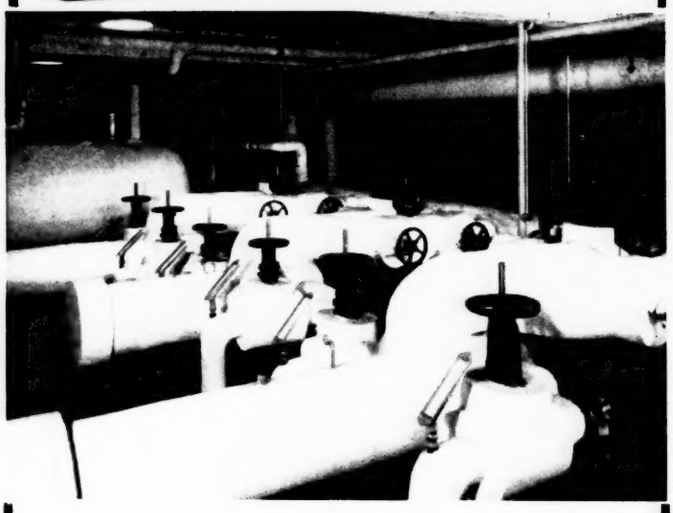
AUTOMATIC TEMPERATURE CONTROL ON QUENCHING TANKS INCREASES SHOT PRODUCTION IN ORDNANCE PLANT

Better, faster production of one important item of ordnance has been made possible by the use of Barber-Colman electric MOTOR-OPERATED Valves for the maintenance of uniform temperature in quenching tanks. Two typical installations are shown in the pictures above and below. A Barber-Colman proportioning valve, capable of taking and holding any position between full open and completely closed, is installed on the cold water supply line. Its position is determined by a thermostat in the side of the tank. As the tank temperature tends to rise or fall, the flow of cold water is automatically adjusted exactly enough to provide a constantly uniform quench temperature. The result is increased production of exceptionally uniform quality. This system is adaptable to a number of other ordnance production requirements. Write for data.



BARBER-COLMAN COMPANY 1224 ROCK STREET ROCKFORD, ILLINOIS

DEPENDABLE, EFFICIENT SERVICE
in Wartime .. as in Peace
WHITLOCK CONVERTORS



Hundreds of WHITLOCK Convertor Installations serve America in time of war . . . guaranteeing ample supplies of hot water for space heating and for protecting the health and morale of workers. WHITLOCK Convertors are efficiently meeting specific conditions in many war plants, including Jacobs Aircraft & Engine Co., North American Aviation, Inc., Norton Co., Colt's Patent Fire Arms Mfg. Co., Allis-Chalmers Mfg. Co., General Motors, Allison Div., and many others.

Write for full information. Our Engineers will be pleased to make recommendations and furnish estimates.

The WHITLOCK MANUFACTURING COMPANY
40 South St., Elmwood, Hartford, Conn.
District Offices in New York, Boston, Chicago, Philadelphia, Detroit, Richmond

(Continued from page 113)

ASSOCIATION OF GAS APPLIANCE AND EQUIPMENT MANUFACTURERS

H. Leigh Whitelaw

at a meeting in Cincinnati, April 28, heard the report of its committee on reorganization, headed by Lyle C. Harvey, Bryant Heater Company. The committee unanimously selected H. Leigh Whitelaw as the new managing director, and has appointed Leonard Macomber as its Washington representative, to replace A. F. Cassidy, who is entering the armed forces. New offices have been established in Room 527, Munsey Building, Washington. Mr. Whitelaw was trained as a production man in American Radiator plants, and in 1913 he became manager of the smokeless boiler department of that company. During World War I he was with the Royal Air Force, and following his return to American Radiator, became executive vice-president of the American Gas Products Corp. until that company was dissolved in 1939. Since then he has been with Jones and Laughlin Steel Corporation, Pittsburgh.

PERSONALS AND PERSONNEL

A. R. JOHNSON

has been appointed by Young Radiator Co., Racine, Wis., as sales and engineering representative in the California territory south of and including Inyo, Kern and San Louis Obispo counties and Clark county in Nevada. He will maintain offices in Long Beach and Los Angeles, Calif.

Mr. Johnson will furnish sales and engineering service on the company's line of heating, cooling and air conditioning products. Prior to his affiliation with Young, Mr. Johnson was associated with the Guy F. Atkinson Co.—Geo. Pollock Co., contractors to the Navy at Long Beach, Calif.

Claude S. Slocum

has been appointed factory representative for General Controls Co., Glendale, Calif., to serve the Rocky Mountain territory and Kansas City, Mo. He will also cover the panhandle section of Texas and northern New Mexico. His new headquarters will be located at 2135 South Adams Street, Denver.

For the past three years Mr. Slocum has been Colorado distributor for General Controls.

W. H. AUBREY

vice-president of the Frick Company, Incorporated, was elected president of the Air Conditioning and Refrigerating Machinery Association, Incorporated, at its annual meeting held in New York, May 14.

Other officers are J. P. Rainbault, General Electric Co., first vice-president; D. W. Russell, Airtemp Division, Chrysler Corp., second vice-president; and P. A. McKittrick, Parks-Cramer Co., treasurer.

INDUSTRIAL DEGREE DAYS
APRIL, 1943

City	Number of Industrial Degree Days	
	55F Base	45F Base
Baltimore	183	43
Buffalo	542	261
Chicago	292	107
Cleveland	356	128
Detroit	383	153
Indianapolis	247	76
New York	303	93
Philadelphia	247	67
Pittsburgh	283	96
St. Louis	115	23

ARMY – NAVY E AWARDS

The Babcock & Wilcox Company, (The Barberton Works).

American Machine and Metals, Inc., East Moline, Ill. (6 months production star).

Southwest Airtemp, (Chrysler Airtemp dealer), Oklahoma City, Okla.

COMING EVENTS

JUNE 7-8—Summer meeting of the American Society of Heating and Ventilating Engineers, to be held at Hotel William Penn, Pittsburgh, Pa.

JUNE 8-11—37th Annual meeting of the Smoke Prevention Association, Hotel William Penn, Pittsburgh, Pa.

JUNE 9-10—34th Annual meeting of the National District Heating Association, to be held at Hotel Schenley, Pittsburgh. For further information write John F. Collins, Jr., Sec'y-Treas., 827 N. Euclid Ave., Pittsburgh, Pa.

JUNE 11-12—Heating, Piping and Air Conditioning Contractors National Association. Meeting of Board of Directors and conference of local Secretaries in place of usual convention.

JUNE 21-24—Annual Convention, National Association of Building Owners and Managers, to be held at Hotel St. Paul, St. Paul, Minn.

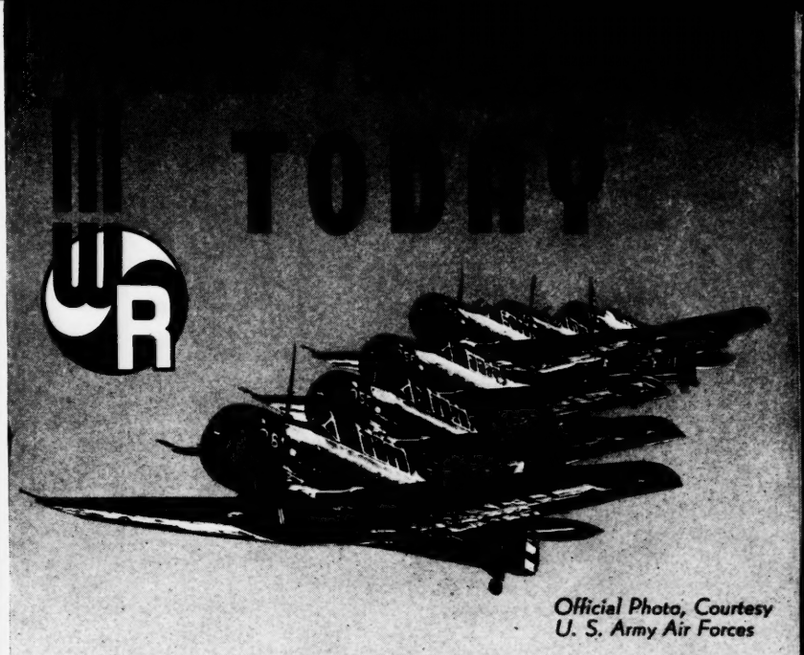
H&V's PHOTOS

FRONT COVER—Official O.W.I. photo, by Palmer.

Pages 35-37—Released for publication by the War Department.

Pages 38-52—Smith, Hinchman & Grylls, Inc., Detroit, Mich., and Twin Cities Ordnance Plant, St. Paul, Minn.

Pages 62-67—Ford Motor Company, Dearborn, Mich.

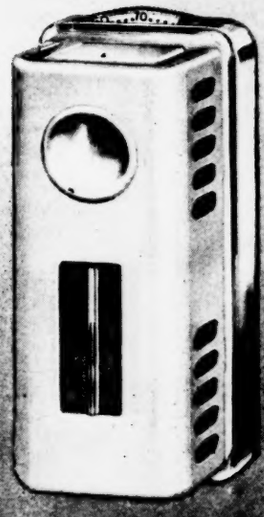


Official Photo, Courtesy U. S. Army Air Forces

That's what America is doing — building for tomorrow so that when the boys come back from "over there" they will know that the folks at home have been in it too.

Today we at White-Rodgers are devoting our time and efforts to develop, design and produce controls for our Military and Naval Air Forces.

Tomorrow these wartime control developments will find many industrial and domestic applications to bring untold efficiency and comfort to a world at peace.



Series 150 Heavy Duty Line Voltage Room Thermostat —will handle multiple unit coolers or heaters—available with locked dial and "on," "automatic" and "off" dial positions to meet all manual needs.

HYDRAULIC ACTION CONTROL

WHITE-RODGERS ELECTRIC CO.

TROOST CASS AVENUE • SAINT LOUIS, MISSOURI

Controls for Heating • Refrigeration • Air Conditioning